



DOMESTIC FOCUS
MOSCOW ANGLES
INDUSTRY AWAY
FROM THE WEST
MAKS REPORT P10

POWERING ON

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U-2 ENCORE

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reveals offer to replace
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FLIGHT

INTERNATIONAL

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AIR SHOW SAFETY

LONG ROAD TO RECOVERY

UK authorities tighten aerobatic display rules
as first response following Shoreham tragedy

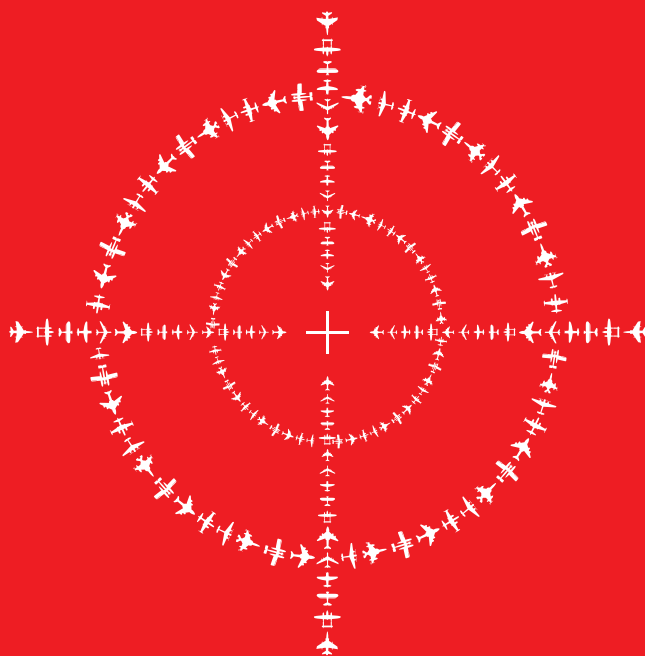


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COVER IMAGE

Our image shows recovery work on the stretch of the A27 near Brighton where 11 people were killed when an air show display went tragically wrong **P7**



BEHIND THE HEADLINES

Stephen Trimble (centre) and James Drew (right) traded Washington DC for the **MAKS** air show in **Moscow**, where they were joined by **BillyPix** photographer **Tom Gordon** (**P10**). Elsewhere, **Mavis Toh** got a **C919** update from Comac in **Shanghai** (**P14**)



NEXT WEEK TRAINING

Ryanair needs to recruit hundreds of pilots as it expands. Our training special explains how it will find them.

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IMAGE OF THE WEEK

Japanese regional airline Amakusa Airlines has taken delivery of its first ATR 42-600, marking the operational debut of ATR turboprops in the country. The 48-seat aircraft, MSN 1202 – leased from Nordic Aviation Capital – will replace the sole Bombardier Dash 8-100 in the carrier's fleet

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ATR

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8%

Flightglobal dashboard

How much Air New Zealand will increase domestic capacity by in year to 30 June 2016 as counter-attack to rival Jetstar

\$20.9bn

Raytheon

Maximum 10-year value to Raytheon as a prime on the US Air Force's TSA III global crew and systems training deal

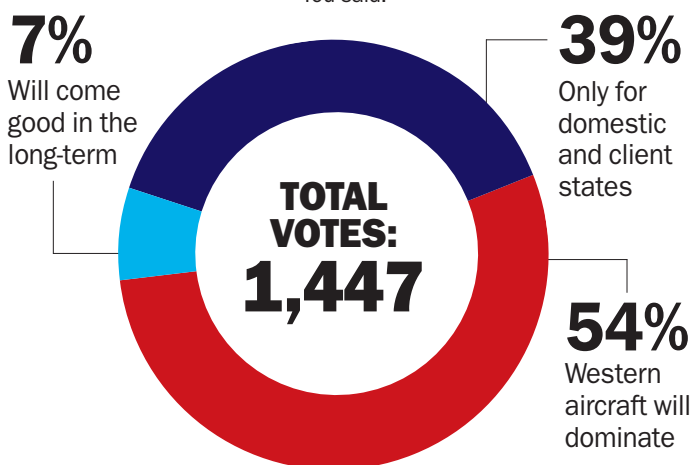
9,922

Arianespace

The mass in kg orbited on the 20 August Ariane 5 launch from Kourou – Arianespace's 513th and 514th payloads

QUESTION OF THE WEEK

Last week, we asked: **Russia's civil aerospace ambitions:**
You said:



This week, we ask: **After Shoreham disaster, do public airshows need safety overhaul?**

☐ Yes, big changes needed
☐ No, they are fundamentally safe ☐ Ban them – too many risks

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Learning from tragedy

With 11 bystanders having lost their lives in the Shoreham air show Hunter crash, a thorough review of display safety and planning is needed. If improvements can be made, they should be

It was a perfect summer's day, with the sun beating down on a large air show crowd, and unbroken blue skies providing a stunning backdrop for displays from vintage aircraft types. It was, in fact, a scene much like that which has been repeated numerous times every year for decades in the UK, where the public has a seemingly unquenchable enthusiasm for aviation.

Following morning attractions including types like de Havilland Tiger Moths, the show commentator raised anticipation levels ahead of the arrival overhead of a classic type hailed for its beauty and elegance.

Barely one minute later, the pilot of the displaying Hawker Hunter failed to pull up from a first manoeuvre at the Shoreham air show, and crashed on a busy main road adjacent to the site. A shocked crowd looked on largely in silence as fire and black smoke rose behind the trees opposite the flightline, with many thinking: but that doesn't happen in Britain anymore.

If safety needs stepping up again in display planning and validation it must happen fast

With 11 deaths confirmed by the time of publication, the Shoreham disaster looks to have been the worst accident of its kind in the UK since a prototype de Havilland DH.110 broke apart above the Farnborough air show in September 1952, killing its two crew and 29 spectators. But the fact that on that occasion supersonic displays were resumed later the same day underscores how much aviation has changed in the ensuing 60-plus years.

As proven at Shoreham, flight safety is still by no means perfect, but the reaction of the show organisers



The disaster that will not be forgotten

– who cancelled further flying and the event's planned second day – and the Civil Aviation Authority must be commended. The latter has for now restricted historic jet-powered types to conducting flybys only at overland events, and halted all flights with other Hunters until more is known about the cause of this tragedy.

To some its decision will appear a knee-jerk reaction, and one leading tabloid newspaper slammed it as “too little, too late” in the wake of the crash. Such criticism fails to consider the huge improvements made to protect air show visitors and innocent bystanders since the risky days when the DH.110 was lost.

Urgent reviews will pull real lessons from the latest disaster, and should reduce the risk of such an event ever happening again. Ultimately, the answer cannot be that air shows should be banned, or that vintage aircraft should be stopped from appearing at them. But if safety must be stepped up again in areas such as display planning and pre-event validation, then change must occur, and fast. ■

See This Week P7

Russia's change of direction

Conspicuous absence was the worrying feature of the MAKS air show. Of course, no-one expected to see a delegation from Kiev filling one of the exhibit halls that line the grounds of the Ramenskoye airfield. And probably few anticipated a significant presence from Western suppliers – particularly from the US, given the economic sanctions and political tensions surrounding the ongoing conflict in Ukraine.

Such absences are common in the aerospace business. Then, as conflicts are resolved and tensions are eased, exhibitors and trade delegations return.

But something more worrisome is developing in Russia. Rather than accept the current situation as a blip in foreign relations, its industry is rapidly turning

its back on Western suppliers. Politics is not the only motivation, since the devaluation of the rouble against the dollar has roughly doubled the cost of using US and European equipment.

Russian industry would be foolish to retreat from Western technology. In an ideal world, Moscow's proud aerospace sector would focus on its areas of competitive strength in combat aircraft, military transports and helicopters.

If Russia insists on preserving a commercial aircraft manufacturing industry, it simply must have access to non-Russian and non-Chinese suppliers to become – and remain – globally competitive. ■

See Show Report P10



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BRIEFING

777-9X FLIES AHEAD WITH FIRM CONFIGURATION

PROGRAMME Boeing is moving into the detailed design stage for its new-generation 777-9X, having announced the firm configuration milestone on 27 August. The company's development team will now focus on the aircraft at the part and assembly level, as well as its electronic, hydraulic and pneumatic systems. A first test example of the General Electric GE9X turbofan-engined 777-9X is scheduled to fly in 2018, followed by the type's entry into service during 2020.

US RAPTORS HEADING FOR EUROPE

DEPLOYMENT The US Air Force has revealed plans to make a first European training deployment involving some of its Lockheed Martin F-22 fighters. Announced by air force secretary Deborah Lee James on 24 August, the move will support the service's European Reassurance Initiative – and is also intended to send a signal to a “resurgent Russia”. James did not disclose when and where the Raptors will be deployed to.

INDIGO ADDS COLOUR TO A320NEO DEAL

COMMITMENT IndiGo president Aditya Ghosh says the carrier's new order for 250 Airbus A320neos will give the Indian airline “a great combination of growth and stability”. Ghosh notes: “The domestic aviation market is hugely under-penetrated, and we will continue to focus here. Less than 1% of the population has access to air travel: the opportunity is staring at us.” Flightglobal's Fleets Analyzer database expects deliveries to run between 2024 and 2032.

FLUTTER TESTING BOOST FOR KC-46 PROGRAMME

TANKERS Boeing has completed a series of flutter tests with its 767-2C tanker development aircraft EMD-1, certifying it to operate with under-wing refuelling pods and its tail-boom stowed. Boeing, which plans to deliver an initial 18 operational KC-46 tankers to the US Air Force by August 2017, says it expects to be “roughly a month beyond” its previous plan to start flying follow-on test aircraft EMD-2 by early September.

QANTAS EYES NEW DESTINATIONS FOR 787-9

ROUTES Qantas could open longer, thinner routes – such as Melbourne to Dallas – using the eight Boeing 787-9s it has on order, says group chief executive Alan Joyce. Noting that the Dreamliners have a greater range but smaller seating capacity than the 747-400s they will replace, he says the net gain of three aircraft will not affect overall carrying capacity. The 787s will be delivered from 2017, with Qantas having options on a further 15, plus 30 purchase rights.

THAILAND RECEIVES AIRBUS HELICOPTERS

ROTORCRAFT The Royal Thai Air Force has taken delivery of four H225M (formerly EC725) rotorcraft from Airbus Helicopters, with another two to be delivered next year under a contract placed in 2012. The aircraft, which can seat up to 28 passengers, will perform tasks including troop transport and search and rescue missions.

EIRTECH RECOVERS FROM HANGAR BLAZE

INCIDENT Two aircraft parked at Eirtech Aviation's Dublin hangar escaped damage during a 26 August fire, the painting specialist says. One of the aircraft was a BAE Systems Avro RJ85 regional jet operated by CityJet, the Irish regional carrier has confirmed. The fire started in a roof section and was contained after about 90min, Eirtech says, adding it has yet to determine the cause of the incident.



Patrick Cardinal/Bombardier

The CS300 featured in the flying display at Le Bourget in June

SALES STEPHEN TRIMBLE MOSCOW

Lessor IFC upbeat on private finance for CSeries order

Rubtsov maintains stalled deal with Bombardier attracted interest of banks after jet made debut at Paris air show

Ilyushin Finance (IFC) is hoping to agree new terms with Bombardier within days on a deal that would preserve the Russian lessor's once-threatened order for 39 CSeries aircraft.

“I’m feeling we may reach a compromise,” IFC general director Alexander Rubtsov said at the MAKs air show in Moscow.

The leasing company has the third-largest CSeries order in Bombardier's backlog, but the deal has appeared in jeopardy since April, when sanctions imposed by the Canadian government prevented the country's development bank from financing IFC's order with the Montreal-based manufacturer.

But the CSeries' debut at June's Paris air show – featuring the CS300 in the flying display and the CS100 on the static line – shifted the tone of the programme in the mind of some private bankers, Rubtsov says.

Previously, private banks had been unwilling to approve an asset-backed financing package for IFC's order, he says. But within days of the Paris show IFC received two or three proposals from banks to finance the order,

on the condition that it first signs an agreement with an operator to take the aircraft.

IFC is now looking to the European market to find an operator to take the CSeries. Several candidates have emerged to accept the aircraft, and IFC expects to conclude an agreement by the end of September, Rubtsov says.

Preserving the IFC deal could help build new sales momentum for the CSeries, after a sequence of delays that led to a corporate restructuring and leadership change at Bombardier. In June, the manufacturer said its new aircraft will beat promised levels for specific fuel consumption, range, noise and reliability, but it has not yet attracted new buyers.

Rubtsov believes the entry into service of the CSeries with Swiss International Air Lines next year will lead to a wave of new orders.

“They need two or three more brand names [as customers],” Rubtsov says. “I’m pretty sure that will happen when the aircraft become operational. Nobody wants to become a tester for a new type of aircraft. They want to see the performance is confirmed.” ■

See Show Report P10



Italy hands over to Sweden after Neuron hits its goals
THIS WEEK P8

ACCIDENT CRAIG HOYLE LONDON

Shoreham prompts CAA clamp-down

UK aviation authority brings in flight restrictions on vintage jets after Hunter crash at air display kills 11 on busy road

The UK Civil Aviation Authority has introduced temporary new flight restrictions at air shows, following what is expected to have been the worst aviation disaster at such an event in more than 60 years.

Eleven people are known to have died when an ex-military Hawker Hunter T7 trainer crashed on a busy road adjacent to Brighton City airport in West Sussex on 22 August, while its pilot was performing an aerobatic manoeuvre during the Shoreham air show.

Shortly after commencing his display, the pilot performed a split-loop manoeuvre before diving to regain speed, but failed to complete a pull-up before the aircraft hit the ground and exploded. Confirmed fatalities include several motorists and bystanders, while the pilot was taken to hospital in a critical condition.

It is unclear whether a strong crosswind at Shoreham during the show contributed to the Hunter ending up as positioned over the main road, instead of the airfield, or whether the aerobatic manoeuvre was performed at a sufficient altitude for a recovery



The jet did not complete a pull-up following a split-loop manoeuvre

to have been completed. The UK Air Accidents Investigation Branch (AAIB) is trying to determine what led to the loss of the aircraft, registered as G-BXFI and owned by Canfield Hunter.

Announcing its action two days after the accident, and fol-

lowing a review of its safety procedures, the CAA said that “flying displays over land by vintage jet aircraft will be significantly restricted until further notice”.

This includes limiting such aircraft to performing flypasts only, with “high energy” aerobatics not

“Displays over land by vintage jet aircraft will be significantly restricted until further notice”

UK CIVIL AVIATION AUTHORITY

permitted”. Additionally, all flight activities involving other Hunter aircraft have been stopped in the wake of the crash, and the authority says it will “act promptly in response to any emerging indications from the AAIB”.

The CAA says it “will conduct additional risk assessments on all forthcoming civil air displays to establish if additional measures should be introduced”.

Its over-land display restrictions cover types such as the Aero Vodochody L-29 and L-39, BAC Jet Provost and Strikemaster, de Havilland Vampire and Venom, and the Folland Gnat – a type involved in a fatal display accident in the UK on 1 August.

However, the measures exclude the “non-aerobatic” Avro Vulcan XH558. ■

SAFETY DAVID LEARMOUNT LONDON

Records show risk to public is very low

The UK’s record in protecting the safety of the public at air shows is impressive. Despite numerous displays performed every year, the Hunter disaster at the Shoreham event is the first time in almost half a century that spectators or people in the airfield vicinity died as a result of an aircraft crash.

In September 1952, a prototype of the de Havilland DH.110 fighter broke up in mid-air at the Farnborough air show, with its wreckage killing 29 spectators. The resulting rules and guidelines for air display management developed by the UK Civil Aviation Authority over subsequent years have been adopted worldwide as an example of best practice.

That is not to say that air show flying displays in recent years have been free of incident or tragedy. There have been frequent crashes where the display pilot has died and, in fact, this was the second fatal jet trainer crash in just three weeks. However, the risk to air show spectators and those in the vicinity has long been regarded as extremely low.

The 22 August crash near Brighton City Airport has, however, called into question whether existing controls on air show safety are sufficient, and precautionary measures will remain in place until more is known about the causal factors. ■ **David Learmount is Flightglobal’s consulting editor and former safety and operations editor**

History of fatal air show accidents

There have been several previous accidents at UK air shows since the Second World War in which both pilots and spectators died:

- **18 September 1948, RAF Manston.** De Havilland Mosquito crash kills both crew members and 10 spectators.
- **6 September 1952, Farnborough.** De Havilland DH.110 breaks up in mid-air. Both crew members killed, along with 29 spectators.
- **20 September 1958, RAF Syerston.** Avro Vulcan wing structural failure, after pull-up

which exceeded structural limits. All four crew and three people on the ground died.

- **20 September 1968, Farnborough.** Breguet 1150 Atlantic crashes during demonstration, killing all five crew and one on the ground.
- **21 September 1980, Biggin Hill.** Douglas A-26 bomber crashes during display, killing its pilot and six passengers. ■





HELICOPTERS

STEPHEN TRIMBLE MOSCOW

Russia reveals fresh interest in tiltrotor family

Russian Helicopters has expressed new interest in developing tiltrotor technologies that could be used to design a family of unmanned and potentially even manned aircraft.

The holding – which includes Russian design houses Kamov and Mil – announced the internal initiative at the MAKS air show.

“The objective at this stage is to identify the technologies required for the further development of a family of Ospreys with varying maximum take-off weight, both manned and unmanned,” Russian Helicopters says.

Although tiltrotor technology is mainly associated with Bell Helicopter’s 60-year legacy of development work, Russian engineers have experimented with tiltrotor concepts since the 1930s. In the mid-1980s Mil launched development of the Mi-30, which resembled the Bell Boeing V-22, but it was cancelled as the Soviet economy crumbled.

In the following decade, the Yakovlev design bureau introduced a concept for a 450kg (990lb)-class tiltrotor unmanned helicopter called the Albatross. The design faded from public view, but in 2012 Russian Helicopters disclosed a new unmanned air vehicle project with the same name, featuring a partial tiltwing rather than only a tiltrotor. That project was reportedly scheduled to begin deliveries in 2017.

Russian Helicopters is providing no details about the scope or timeline for its new effort, but clarifies its ultimate goal. “The aim of the project is to create a family of high-speed, multi-purpose rotary-wing aircraft,” it says, suggesting that smaller and larger vehicles could also emerge.

Russian Helicopters emphasises tiltrotors’ ability to travel at higher speeds and longer distances than a conventional helicopter, while retaining the ability to land in small spaces. ■

See Show Report P10

UNMANNED SYSTEMS BETH STEVENSON LONDON

Italy hands over to Sweden after Neuron hits its goals

Alenia Aermacchi says European UCAV met all expectations during 12 stealth missions

Italian industry has completed its share of testing of the pan-European Neuron unmanned combat air vehicle, which saw it carry out 12 sorties from Decimomannu air base in Sardinia.

Announced by Italian lead Alenia Aermacchi on 25 August, the activity involved flight tests to assess the UCAV’s stealth characteristics across a variety of conditions, and met “all established goals”.

“The 12 highly sensitive sorties have allowed [us] to verify the characteristics of Neuron’s combat capability, its low radar-cross section and low infrared signature, during missions flown at different altitudes and flight profiles and against both ground-based and air radar ‘threats,’” the company says. The latter involved the use of a Eurofighter Typhoon combat aircraft.

“During the deployment in Italy the Neuron confirmed its already ascertained excellent performance and high operational reliability,” Alenia Aermacchi says.



Dassault is leading the vehicle’s six-nation development effort

The UCAV demonstrator will now be moved to Sweden, where Saab will lead testing at the Vidsel test range with low observability trials and tests of weapons delivery from the aircraft’s internal weapons bay.

The Neuron was first flown in France in December 2012, where it completed a 100-flight campaign conducted by Dassault.

This phase included testing the UCAV’s sensor, datalink and stealth characteristics, and was also focused on increasing its flight envelope.

The six-nation Neuron development effort is led by Dassault, also joined by industry partners Airbus Defence & Space, Hellenic Aerospace Industry, RUAG and Thales. ■

MANUFACTURING

Production starts on A350-1000 wing as Airbus gears up for final assembly

Airbus has commenced production of the A350-1000 wing at its specialist plant in Broughton, UK. The wing for the largest member of the A350 fami-

ly is based on that for the -900, but features modifications including an extended trailing edge. Work on fixed trailing edge sections began in May, and the

Broughton facility will assemble components also including composite wing covers.

Rolls-Royce is developing the higher-thrust Trent XWB-97 engine for the type, which the manufacturer expects to fly on an A380 testbed towards the end of this year.

Final assembly of the A350-1000 is scheduled to begin in the first quarter of 2016. Airbus says it has so far received orders for 169 of the 366-seat type, with Flightglobal’s Fleets Analyzer recording these as currently set for operation with eight airlines. ■



Modifications from the -900 include an extended trailing edge



Stealthy UAV taking
shape to target
F-35 operations
SHOW REPORT P10

THIS WEEK

INQUIRY DAVID KAMINSKI-MORROW LONDON

Battery fire 787-8 'would keep flying'

Boeing's analysis shows effect of Ethiopian ground incident would not compromise structural integrity if it occurred in flight

Boeing has determined that the Ethiopian Airlines 787-8 badly damaged by a ground fire would have remained structurally intact if the incident had occurred in flight.

The fire broke out at London Heathrow in July 2013 after a short-circuit in the emergency locator transmitter led to thermal runaway in its lithium battery pack. It destroyed surrounding insulation blankets and the aircraft suffered extensive heat damage in the aft crown, just forward of the vertical fin, over an area of some 9.5m² (100ft²).

The UK Air Accidents Investigation Branch says the aircraft structure sustained "significant" resin loss and ply disbanding in the fuselage skin and frames.

Structural load modelling indicated that the severity of the damage had "compromised" the aircraft's ability to carry flight loads.

As part of the inquiry the investigators sought to assess whether there would have been a similar threat to structural integrity if the fire had broken out during flight.



The twinjet suffered extensive heat damage in the aft crown while parked at Heathrow in July 2013

Boeing developed two fluid-dynamics models to analyse the thermal characteristics of the transmitter battery ignition and propagation of the fire.

It used these models to examine the effects of temperature in the fuselage crown and the effect of external cooling from airflow at 35,000ft altitude and a cruise speed of Mach 0.85.

The thermal models indicated that, for the in-flight scenario, the

area of elevated temperature in the fuselage crown would have remained local to the heat source, rather than expanding.

Convective heat loss during flight would result in "significantly different temperatures" compared with those in the parked aircraft, says the inquiry, and would "substantially reduce the progression" of a fire.

Finite-element modelling of the fuselage structure showed

that – in a worst-case scenario, affecting a group of 18 stringer-frame quadrants – the aircraft would have been unable to maintain cabin pressure. But the fuselage would have still been capable of carrying flight loads.

Boeing's analysis also examined a second scenario, with the damage covering five quadrants, and this predicted that cabin pressurisation would have been sustained. ■

SAFETY

Assurances sought over Lithium cells

Investigators are seeking assurances that aircraft systems powered by lithium batteries are adequately protected against short-circuit, after formally attributing the Ethiopian Airlines Boeing 787 ground fire to thermal runaway in the emergency locator transmitter (ELT).

The aircraft sustained serious damage in the fire which broke out while it was parked, empty, at London Heathrow on 12 July 2013.

The UK Air Accidents Investigation Branch has determined that damage to the transmitter, combined with the absence of neighbouring systems capable of ignition, has "identified [it] as the source of the fire".

The blaze in the ELT, a Honeywell Rescu 406AFN model, resulted from uncontrolled energy release, prob-

ably from an external short circuit in combination with early depletion of a single cell in the lithium-manganese dioxide battery.

Investigators believe the short-circuit resulted from battery wires being crossed and trapped under the ELT battery compartment's cover-plate. The trapped wires in the ELT compromised the seal of the battery cover-plate, allowing hot gas and flames to affect the 787's composite fuselage.

Absence of cell segregation in the battery enabled the initial thermal runaway to propagate to the remaining cells. Insulation blankets allowed heat to remain close to the fuselage to maintain the fire, and it spread through the space between the blankets and the aircraft skin. ■

How Dreamliner was returned to use

Ethiopian's 787-8 (ET-AOP) had arrived at London Heathrow at 05:27 on 12 July 2013 after an uneventful service from Addis Ababa and parked at stand 326 at about 05:40.

No defects were reported by the flight crew and after the passengers and crew had disembarked, the twinjet was towed to the remote stand 592 to await its next flight later that day.

Ground power to the Dreamliner was turned off – although the umbilical cables were left in place – before an engineer secured and left the aircraft at around 07:30.

At around 15:34 an employee in the air traffic control tower

noticed smoke emanating from the 787 and alerted the fire service, which arrived on scene around 1min later, discharging water and foam onto the exterior of the fuselage.

Having removed several ceiling panels, the site of the fire was located towards the rear of the cabin and the blaze finally extinguished around 25min after firemen entered the aircraft.

After five months on the ground at Heathrow while repairs to the fuselage were undertaken, the Dreamliner returned to the skies on 21 December 2013 to perform a short test flight. It was returned to service later that month.

MAKS 2015

The economic and political backdrop could hardly have been worse for the MAKS air show organisers. A devalued rouble and national recession have destabilised Russia's aerospace industry, while political sanctions kept most Western exhibitors away from the event, staged at Ramenskoye airfield near Moscow.

But Russian industry officials say they are regrouping, and now-distant partners are being exchanged for national and Chinese firms. New capabilities are still being pursued, although only time will tell if they can survive the current economic crisis.

Report by James Drew and Stephen Trimble, with photography from BillyPix



PROGRAMME

Production of Il-96 fuelled by military needs

Production of the Ilyushin Il-96 could continue for nearly a decade to support the Russian military's requirements for an aerial tanker and other special missions, United Aircraft (UAC) chief executive Yuri Slyusar says.

Continued production of the four-engined widebody also offers a reprieve for the Voronezh Aircraft Production Association (VASO), which has been a UAC

The plant's future had been in doubt since the conflict between Ukraine and Russia

subsidiary since 2007. The plant's future had been in doubt since the conflict between Ukraine and Russia raised questions about access to rights to build the Antonov An-148 regional airliner.

VASO manufactured passenger-carrying Il-96s until UAC withdrew the type in 2009, allowing only the freighter version to continue in production. In January, Russia's defence ministry awarded UAC a contract to convert two Il-96-400TZ tankers, which will use OPCD-1 refuelling pods developed for the Il-78. ■

SURVEILLANCE

Stealthy UAV taking shape to target F-35 operations

Model of low-observable Russian concept displayed by electronic warfare specialist KRET

Russia could be working on a low-observable unmanned air vehicle that would use deeply-integrated electronic warfare systems to stay hidden from radars and could target the Lockheed Martin F-35.

The tip-off came from electronic systems producer Concern Radio-Electronic Technologies (KRET), which exhibited a model of such an aircraft at the show.

According to KRET's first deputy chief executive officer Vladimir Mikheev, the model is more than just a sleek promotional display, but an advanced military UAV being developed by Russia's United Aircraft (UAC).

The company is a subcontractor on the project, he says, providing the communications, radar, electronic warfare and self-protection systems, as well as the ground control station.

Speaking via a translator, Mikheev told *Flight International* that KRET is involved with UAC in two military UAV projects – one in development and another in the concept phase. He declines to name the project or say which UAC design bureau is in charge of the activity, but confirms some of the aircraft's key capabilities.

Mikheev says the UAV is designed to detect stealth aircraft in the same vein as China's "Divine Eagle" project, which he claims is based on technology "borrowed" from Russia and the USA.

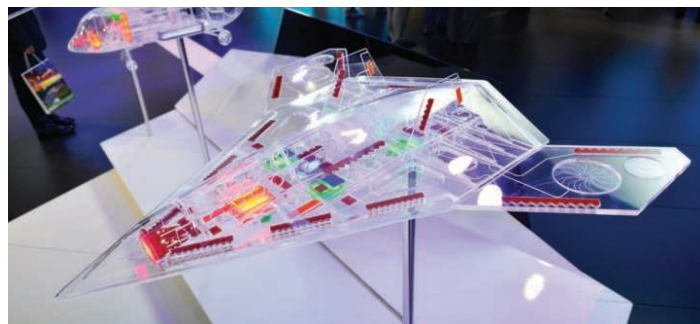
DETECTION

Such aircraft aim to detect low-observable US combat aircraft using X-band and UHF radars, specifically the Lockheed F-22 and F-35 and Northrop Grumman's B-2. But airborne surveillance would be just one of the UAV's capabilities. Mikheev says KRET is providing a deeply-integrated electronic warfare system that results in a protective electromagnetic sphere around the aircraft to counter air-to-air missiles, and cloaks it from radars.

The unmanned aircraft model closely resembles Northrop's carrier-based X-47B demonstrator, but adds two lift fans on each wing and vertical stabilisers.

Mikheev says the UAV's avionics, radar and electronic warfare systems are derived from those being produced for the Sukhoi Su-35 multirole fighter and the Kamov Ka-50 attack helicopter. KRET is also deeply involved in the Russian air force's Sukhoi T-50 fighter project.

In an article published on the company's website, Mikheev says Russia has been competing with the USA in the realm of electronic warfare "for our entire lives" – adding that KRET decided to bring in the next era of electronic warfare systems five years ago. ■



The model is said to represent an aircraft being developed by UAC



Could the 'Sea Monster' rise again?
SHOW REPORT P12

MAKS 2015
SHOW REPORT

PRODUCTION

Domestic suppliers to board Superjet

Weak rouble forces Sukhoi to seek alternatives to some Western technologies currently used on debt-stricken programme

Sukhoi Civil Aircraft (SCAC) has unveiled a plan to reduce the cost of producing the Superjet by \$2.6 million per aircraft, by replacing Western suppliers with Russian manufacturers.

Announced by United Aircraft chief executive Yuri Slyusar, the move is aimed at stabilising the programme's costs following the devaluation of the rouble against the US dollar.

The Superjet is assembled by SCAC in Komsomolsk-on-Amur, but is packed with European and US technologies, ranging from B/E Aerospace passenger seats and lavatories to UTC electrical systems, Thales avionics and Parker Aerospace hydraulics.

As the value of the rouble has fallen by half against the dollar over the past two years, the cost of Western-supplied equipment has more than doubled. That cost volatility has complicated



European and US-supplied system costs have doubled since 2013

SCAC's attempts to stabilise the Superjet programme.

Earlier this year the Russian government paid off about \$2 billion of SCAC's debts, reducing the programme's debt load to about \$600 million. Meanwhile, state-owned lessor GLTK signed a deal to buy 32 Superjets for delivery between 2015 and 2017, with options for another 28.

The next step for Sukhoi will be to stabilise the programme's cost structure, which requires the company to switch to local suppliers that will receive payments in roubles rather than dollars.

Russian aerospace companies have long experience in manufacturing major systems and electronics for military-rated aircraft, but are less known for participat-

ing in commercial programmes that require airworthiness certification from the US Federal Aviation Administration and European Aviation Safety Agency to be marketable outside of Russia.

Slyusar, however, says Russian companies are "ready for this".

One such supplier, Rostec holding Technodinamica, displayed several Russian-built alternatives to Western hardware at the show. Curtiss-Wright currently supplies the Superjet's fire protection system, but has partnered with Technodinamica to offer a different version, using computers and a fire retardant dispensing system provided by the latter.

Technodinamica and other Russian suppliers will begin to take over certain systems as deliveries by Western companies reach minimum contractual guarantees, says chief executive Maxim Kuznyuk. ■

TURBOPROPS

UAC weighs reviving Il-114 at new production site

United Aircraft (UAC) is looking favourably on re-starting production of the Ilyushin Il-114 regional turboprop – although a final decision has still not been made, says chief executive Yuri Slyusar.

Only 20 Il-114s had been delivered by the time the line was shut down in 2013, despite the type being available for more than 23 years.

But a combination of Russia's ageing turboprop fleet, unmet demand on regional routes and economic sanctions that are restricting the country's access to newer models have now forced UAC to reconsider the once-abandoned Il-114.

The estimated \$275 million development plan, if approved, would require airframe and engine upgrades in addition to a new certification programme, Slyusar says.

In recent years, Russia has considered alternatives to reviving the Il-114, such as the Antonov An-140 and the Bombardier Q400. However the Ukrainian-designed An-140 is no longer accessible to Russia's industry, and a plan to locally assemble Q400s collapsed more than a year ago because of sanctions by the West.

Although the Il-114 was originally built in Tashkent, Uzbekistan, UAC is considering four other sites for the revived production system: Kazan, Nizhny Novgorod, Ulyanovsk and Voronezh.

The assembly site location, upgrade requirements and potential demand will be evaluated in UAC's business case for reviving production of the regional design. "We hope that it will have a positive decision," Slyusar says. ■



Only 20 examples of the turboprop had been delivered when production shut down in 2013

PROPOSAL

CEO previews 'risky' restructuring plan

A radical move to restructure UAC around market sectors rather than historically-powerful design bureaus could see the company reorganised into five major holdings.

Chief executive Yuri Slyusar previewed the restructuring concept on 26 August, saying the proposal has not been approved and is "high risk".

UAC's new leadership is clearly motivated to reduce costs and im-

prove productivity amid a national economic crisis that has hit Russia's aerospace and defence sector hard.

Since forming in 2006, UAC has been dominated by giants of the Soviet era including Ilyushin, Irkut, RAC MiG, Sukhoi and Tupolev. But it could instead be organised around market sectors, such as commercial, military, transport, special missions and repair centres, Slyusar says. ■

DETECTION SYSTEMS

China's A-Star targeting sensors at B-2 and F-22

Privately-owned Chinese sensor company Beijing A-Star Science and Technology has unveiled a suite of air-to-air and air-to-ground sensors in development for the latest Chinese and Russian fighters.

Wang Yanyong, the company's technical director, confirms that two systems – the EOTS-89 electro-optical targeting system and the EORD-31 infrared search and track sensor – are in development for China's Chengdu J-20 and Shenyang J-31 fighters.

Marketing brochures on A-Star's booth suggested that the J-20 could use the passive sensors to detect and aim missiles against the Northrop Grumman B-2 bomber

and Lockheed Martin F-22 fighter, even while its radar is being jammed by a Boeing EA-18G Growler. It lists notional detection ranges for the B-2 at 81nm (150km) and for the F-22 at up to 60nm.

Both systems have completed ground testing in a laboratory, and are now ready to enter flight testing, he says. China's AVIC is considering integrating the sensors on a testbed aircraft, then could decide to trial them on the J-20 and J-31. Operational status is at least one year away for both sensors, but possibly longer, he adds.

A-Star says it exhibited the systems to attract buyers from Russia and Commonwealth of Independent States countries. ■



WING-IN-GROUND-EFFECT

Could the 'Sea Monster' rise again?

Almost 50 years after the Soviet "Caspian Sea Monster" was born, some in Russia hope to revive the ekranoplan, or wing-in-ground effect vehicle, for the tourism sector. The original developer for the Soviet military, the Alexeev Central Hydrofoil Design Bureau, used the show to suggest redesigning the Sea Monster to carry between 50 and 150 tourists – instead of nuclear weapons – across the ocean at 135kt (250km/h).

TRACKING

T-50 radar systems 'production ready'

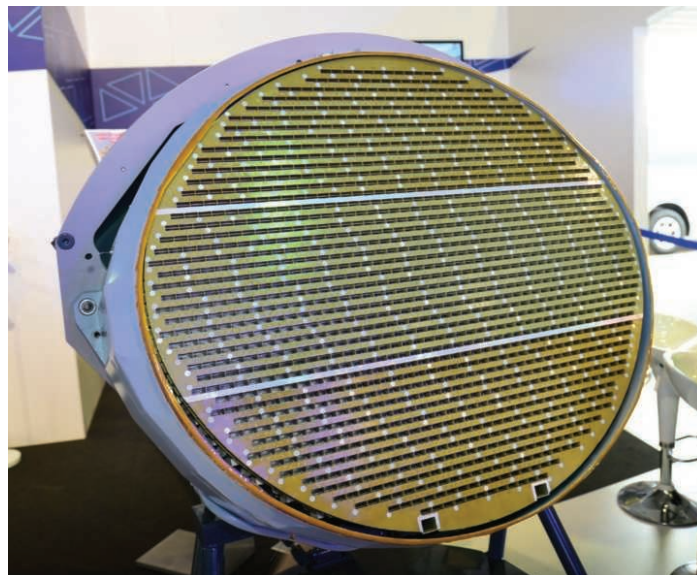
Design of active phased array for Russia's fifth-generation fighter described as "stable" ahead of final developmental tests

The Tikhomirov NIIP radar system built for Russia's first fifth-generation fighter, the Sukhoi T-50, is "99% ready" to enter serial production, but must first complete a series of development tests.

The active phased array radar consists of one forward-looking X-band radar in the nose section and two side-scanning arrays, as well as L-band antennas along the wing flaps. The system was put on display for the first time at the show.

Deputy chief designer of NIIP radar systems Andrey Sukhanov says he does not have a timeline for when the testing will conclude, but adds that he is confident the overall design is stable, barring minor tweaks.

"A lot of different equipment and items are involved in this testing, because it's not only the radar being tested but the avionics of the entire system," he says. "This is similar to the [Lockheed Martin] F-22, and the F-35 testing that is taking place now. It does not depend on which country or manu-



Rostec claims the technology can track up to 30 airborne targets

facturer, because the problems encountered are always the same.

"If the testing finds some things that require finalisation or adjustments then it will be done, but as for our estimate, the radar is 99% ready for serial production."

Sukhanov provides little detail of the radar's capability other than to say it comes with air, ground and maritime modes and is easily adaptable to new air-launched weapons. He is also hesitant to reveal the number of threats the

radar can track and target simultaneously, beyond saying that this will be "no fewer than the Su-35". State defence exporter Rostec claims that aircraft can track up to four ground or 30 airborne targets out to 216nm (400km), while simultaneously attacking up to eight airborne threats.

The super-maneuvrable supersonic fighter was the lead attraction at MAKS, and United Aircraft chief executive Yuri Slyusar said during a 26 August press conference that the programme is on track, despite reports of a slow-down. The Russian defence ministry's latest plan is to procure 55 T-50s through 2020, although the go-ahead for that number depends on the performance of the first 12.

The Russian government's lukewarm embrace of the T-50 stands in contrast to the stated importance of the project – both in terms of its nationalistic appeal and in stimulating the domestic aerospace industry. ■



787-8's hydraulic fluids must be changed – FAA
AIR TRANSPORT P14

MAKS 2015
SHOW REPORT

MISSILES

BrahMos bids to deliver more speed

Indian-Russian joint venture aiming to take current variant to faster than Mach 5 as step to clean-sheet hypersonic weapon

Indian-Russian joint venture BrahMos Aerospace wants to double the speed of its ramjet-powered cruise missile to beyond Mach 5 as an interim step towards the development of a clean-sheet “BrahMos-II” hypersonic weapon.

BrahMos general manager of marketing and export Praveen Pathak says the company’s pursuit of a hypersonic weapon remains at the decision phase and could take seven or eight years to fully realise.

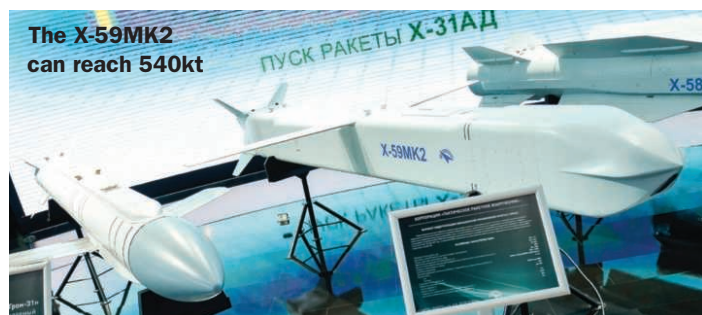
The central challenge is finding the best materials to protect the hypersonic air vehicle against the extreme temperatures and shockwaves experienced during high-speed flight, he adds. The current BrahMos missile

travels at up to M2.8, but the goal is to develop a weapon capable of sustaining a maximum speed of M7.0 or greater, using a supersonic combustion ramjet, or scramjet, engine.

Russia, India, China and the USA are all pursuing hypersonic missiles, each with the aim of outrunning the other’s air defence systems and boosting the kinetic energy of each strike.

“The main problem scientists are facing is how to withstand so much heat,” says Pathak. “Everyone is driving to have something faster, because whoever gets there faster will be the leader.”

India is integrating the air-launched variant of the BrahMos with its Sukhoi Su-30MKI multi-role fighters. ■



SECTOR

X-59MK2 cruise missile export ready

New weapons on display at the show included the Grom-E1 and Grom-E2 missiles being developed by Russia’s Corporation of Tactical Rocket Armament. The company declines to provide details of the wingkit-equipped type’s capabilities,

but also exhibited its export-ready X-59MK2 cruise missile.

The infrared-guided weapon is powered by a turbojet engine to achieve speeds of between 405kt (750km/h) and 540kt, with a 156nm (290km) range. ■



Software replicates the type’s sensor and weapon capabilities

TRAINING

Simulator for upgraded MiG-31

Dinamika has unveiled its twin-seat flight simulator for the Russian air force’s newly-upgraded RAC MiG-31BM supersonic interceptor, with the company’s chief designer of technical training systems telling *Flight International* that the device replicates the full range of combat scenarios made possible via the modernisation.

“With modified avionics, it’s possible to do space navigation, it’s possible to use the new radar, and it’s possible to have communication between four aircraft,” says Valeriy Ivanenka. “You can train with this precision in the simulator.”

The most significant changes are new avionics panels in the aft cockpit and software that replicate the type’s new combat capabilities and weapon effects.

“It’s possible to recreate all flight stages and to simulate more than 300 different failures,” says Ivanenka, who adds that “four or five” simulators have been delivered so far under a contract signed with the Russian defence ministry in 2011.

Russia has issued contracts to upgrade 100 of its MiG-31s, with structural improvements also intended to keep the 1980s-era aircraft viable out to 2030. ■

AIRPORT SYSTEMS

Technodinamica in drive to join electric taxi ranks

Russian systems integrator Technodinamica has launched development of an electric ground taxiing system (EGTS) for commercial narrow-body aircraft, joining a competitive race that already includes a Honeywell/Safran partnership and Israel Aerospace Industries.

Technodinamica revealed an electrically-driven system embedded in the nose gear of a Tupolev Tu-204, which was selected for laboratory demonstration purposes only. The company is targeting platforms including the Irkut MC-21 and Western-built aircraft, says chief executive Maxim Kuzyuk.

“It is critical for us to go outside [Russia], because our market is narrow and defined and we have already 50% of this market. Our goal is to go abroad with new products,” he says.

A live testing aircraft has not yet been selected to demonstrate

the technology, but Kuzyuk says it will be ready to move into production two years after ground tests begin on an aircraft. That means it could be available as early as 2018, when the MC-21 is scheduled to enter service. The company also is considering retrofit applications for the equipment, he adds.

Early analysis indicates that the EGTS is capable of saving about 200kg (440lb) of fuel for a Tu-204-sized aircraft on a 1.5h-long flight cycle.

So far, Technodinamica – which consolidates 37 Russian aviation electronic systems houses under the Rostec corporate banner – has focused development testing on using an auxiliary power unit to propel an electric motor, but it also is evaluating how to blend supplemental power provided by onboard batteries to enable the design to begin moving the aircraft. ■



PRODUCTION MAVIS TOH SHANGHAI

Comac plays safe with dual supplier system for C919

Critical components to be produced by two manufacturers to ensure quality and avoid delay to Chinese programme

Comac is using a dual supplier system to manufacture critical and potentially challenging parts of the C919 airframe, to ensure quality control and prevent any major delays to the programme.

The parts include the aircraft's aft fuselage, as well as its vertical and horizontal stabilisers, all of which are made of composites, Comac's chief engineer Jiang Liping told Flightglobal during an interview in Shanghai. Chinese suppliers are unfamiliar with the use of composites, and the airframer's concern is that the quality and strength of the parts produced by one supplier may not match the required standards, she adds.

In one example of such an issue, Comac was required to strengthen the first aft fuselage delivered by Shenyang Aircraft Corporation. It also has engaged two suppliers to build the C919's centre wingbox and mid fuselage, due to anticipated complexities in the wing-to-body join of the aircraft.

"We do this so that we have a backup," says Jiang. "The costs will go up, but this is for quality control and also to ensure that

the programme's timeline is under control."

Jiang adds that Comac has stuck to its main suppliers so far, since their parts have generally met required standards.

Comac has largely completed the final assembly of the first flight test aircraft for the C919 programme at its facility near Shanghai's Pudong International airport, with all remaining systems expected to arrive by October.

Jiang says the installation of harnesses, cables and pipes has started, while a second CFM International Leap-1C engine is due to arrive during September.

After being rolled out before year-end, aircraft 101 will undergo pre-flight testing before it can make its first flight during 2016. Under the best circumstances, pre-flight preparation could be completed within four months, says Jiang. This means that the C919 could make its first flight around next April or May.

In September Comac will also start the final assembly of aircraft 102, the mid-fuselage section of which has already arrived. ■



A failure of power control units could occur due to the problem

MANDATE STEPHEN TRIMBLE WASHINGTON DC

787-8's hydraulic fluids must be changed – FAA

Airlines must drain and replace a certain kind of hydraulic fluid found in the Boeing 787-8 fleet to prevent a possible safety problem, the US Federal Aviation Administration says.

Skydrol LD-4 is used in each of the 787-8's three hydraulic systems, which provide power to move the control surfaces on the wings and tail. Boeing discovered nearly a year ago that the way the fluid interacts inside the power control units for the control surfaces can cause particulates to form. This could restrict the operation of the electro-hydraulic servo valves that actuate the moving control surfaces, according to an airworthiness directive released by the FAA.

The flight crew would be warned of the problem by status messages displayed on the en-

gine indication and crew alerting system. In theory, it could cause the power control units to fail, leading to "reduced controllability" of the aircraft.

Boeing issued a non-mandatory service bulletin to all 787-8 operators last November, urging them to inspect the power control units and replace Skydrol LD-4 with a different hydraulic fluid. The FAA then issued its airworthiness directive, mandating US operators to make inspections and change the fluid within 36 months.

Boeing says the problem with Skydrol LD-4 fluid is limited to an interaction with the servo valves used by the 787-8, and poses no risk in other aircraft.

The problem had been addressed on two-thirds of the global 787-8 fleet before the FAA's airworthiness directive. ■



FLEET

Korean first to fly both 747-8s

Korean Air has received its first passenger example of the Boeing 747-8, with a 368-seat capacity. Flightglobal's Fleets Analyzer database shows the airline has ordered 10 747-8s, with four to be delivered this year and the remainder by 2017. The carrier has become the first operator to field the 747-8 in both its passenger and freighter variants.



Swiss all set for
777-300ER
simulator
AIR TRANSPORT P16

ACCIDENT DAVID KAMINSKI-MORROW LONDON

Speed data error led to 767 tail-strike

Aeromexico dispatcher used zero-fuel weight in calculations for crew of twinjet badly damaged during take-off from Madrid

Spanish investigators have found that an Aeromexico crew entered incorrect speed data into a Boeing 767-200 before the aircraft suffered a serious tail-strike on departure from Madrid on 16 April 2013. The data had been calculated by a dispatcher in Mexico, who unintentionally used zero-fuel weight as the basis.

Investigation body CIAIAC says that the reduced weight generated low take-off reference speeds – including a rotation threshold of 118kt (219km/h); nearly 40kt below the 156kt required for the aircraft's actual weight, but that the unusual figures "did not attract the attention of the crew".

As the 767 accelerated along Madrid's runway 36L it failed to rotate at the 118kt reference speed. Flight-data recorder information shows that it began to rotate at 124kt, but reached a pitch of 12° before the main gear lifted off. This increased to just over

14°, but the 767 was travelling at 138kt – too slowly to climb away, and the main gear touched down again 4s later. The threshold pitch for a tail-strike on the type is 13.1°, says CIAIAC.

Both thrust levers were advanced and the aircraft became airborne again at 141kt. Its pitch increased to 15° as it left the runway and the aircraft's stick-shaker activated twice in quick succession. Despite these alerts, the pilots continued to increase the aircraft's pitch, to 19°, as it commenced its climb. This indicates that the crew "failed to recognise" the risk of a stall, CIAIAC says.

The 767's climb stabilised as it accelerated, and the main gear was retracted at 90ft. But the aircraft had sustained severe damage during the tail-strike, including serious structural material loss in the region of the auxiliary power unit. It suffered pressurisation problems and the crew decided to return to Madrid.



The aircraft returned after experiencing pressurisation problems

Meanwhile, the pilots of an Air Europa Airbus A330, several places behind the 767 for departure, reported seeing objects on the runway as they took off 30min later. While their notification prompted a decision to inspect the runway, it came too late to prevent another of the carrier's A330s, following immediately behind, from striking the debris.

The aircraft's nose-gear was damaged and its crew chose to return to the airport, landing around 3.5h after the 767 following a hold to burn off fuel.

None of the occupants on board the 767 (XA-TOJ) or the A330 was seriously injured. The Aeromexico aircraft was subsequently written off, due to the severity of the damage caused. ■

INVESTIGATION GREG WALDRON SINGAPORE

Indonesia looks for cause of latest Trigana crash

The 16 August crash of a Trigana Air-owned ATR 42-300 extends what has been a patchy safety record for the Indonesian carrier.

Debris from the 1988-built twin turboprop (PK-YRN) was

located on a mountainside in eastern Papua, with the aircraft believed to have hit the slope of Mount Tangok in Okbape district. It came down while still around 8.1nm (15km) away from

its intended destination of Oksibil, during a flight from Jayapura's Sentani airport. All 49 passengers and five crew members were killed.

The aircraft's cockpit-voice recorder was located and submitted to the Indonesian National Transportation Safety Committee, while its flight-data recorder was retrieved on 20 August.

Prior to this crash, Trigana had been involved in 19 serious safety incidents since 1992, which resulted in the loss of eight aircraft and major damage to 11 others, with the deaths of 14 passengers and nine crew. Flightglobal's Ascend Fleets database records that its previous most serious accident occurred on 17 November 2006, when a de Havilland Canada DHC-6 Twin Otter crashed into Mount Gergaji while operat-

ing the Mulia-Illaga route, killing nine passengers and three crew.

Trigana's past list of mishaps also involved 13 other Twin Otters, three Fokker F27s, one Antonov An-72 and another ATR 42-300. The latter (PK-YRP) was written off on 11 February 2010, when engine failures forced the crew to perform an emergency landing in a field. Of the 52 people on board, only one passenger was injured.

Flightglobal's Fleets Analyzer database records the privately-owned carrier as now operating 17 aircraft: eight older-model Boeing 737s, five other ATR 42-300s, three ATR 72-200s, and one Twin Otter. It flies domestic scheduled and charter passenger and cargo services from its Jakarta Halim airport main base to over 20 airports across Indonesia. ■



Wreckage was found strewn on a mountainside in eastern Papua

DESIGN MAVIS TOH SINGAPORE

AVIC plans first flight of MA700 for early 2017

Chinese airframer AVIC has frozen the design of its Xian MA700 turboprop, with final assembly of the first flight-test example scheduled to be completed by the end of 2016.

A maiden sortie should follow in early 2017, ahead of certification and service entry in 2019, AVIC says.

The airframer has named Okay Airways and Joy Air as launch customers for the turboprop, but admits that neither carrier has placed a firm order for the MA700. Instead, both have signed what it describes as “collaborative agreements”, with the eventual aim to each take 30 aircraft.

In addition to Okay and Joy, nine other parties have signed letters of intent to purchase MA700s

AVIC anticipates that the airlines will firm up these tentative commitments at the end of 2018, when it will be able to disclose pricing and delivery schedules.

In addition to Okay and Joy – both customers for AVIC’s current MA60 turboprop – nine other parties, including operators in Cambodia, Nepal and Africa, plus Chinese lessors CDB Leasing and CMB Leasing, have signed letters of intent to purchase a further 125 MA700s, AVIC says.

The aircraft will be powered by Pratt & Whitney Canada PW150C engines, and have a maximum take-off weight of 26,500kg (58,400lb) with a range of 1,475nm (2,700km). It will also feature Rockwell Collins Pro Line Fusion avionics and Parker fly-by-wire controls, making it the first turboprop to enter service with the advanced control system. ■

Additional reporting by Greg Waldron in Singapore

MODIFICATION MICHAEL GUBISCH LONDON

Swiss all set for 777-300ER with transformed simulator

Training division converts Airbus installation to Boeing systems ahead of flagship’s arrival

Zurich-headquartered Swiss is continuing its preparations for the arrival of the Boeing 777-300ER in its long-haul fleet, with the conversion of an Airbus A330/A340 simulator at its flight training division.

Swiss Aviation Training, also located in Zurich, removed around 9t of cockpit installations and related equipment from one of two A330/A340 full-flight simulators in order to turn the device into a 777-300ER cockpit replica.

Some 6t of new systems were installed over a four-month period after two years of planning in partnership with simulator manufacturer CAE and Boeing.

This is the first time that an Airbus widebody simulator has been converted to a 777, says Swiss Aviation Training. It was a challenge to develop the simulator while the final configuration of the carrier’s on-order 777-300ER fleet was “far from confirmed”, says the training firm’s chief operating officer David Birrer. However, he adds the sim-



The facility is “99.9% congruent” with the nine aircraft on order

ulator is “99.9% congruent” with the first of nine aircraft scheduled to join the fleet in January 2016.

The device is configured to simulate automated communications between aircraft and ground stations, plus the use of Apple iPad-based electronic flight bags.

The campus will also install a 777 cabin emergency evacuation training device by October, and a cabin service trainer by January.

Swiss placed an initial commitment for six aircraft in 2013

and added a further three to its order this year. The 777-300ER is intended as the carrier’s new long-haul flagship.

Meanwhile, sister firm Lufthansa Flight Training has installed a 777-300ER simulator at its site in Frankfurt, which it received directly from Lockheed Martin. It is Lufthansa’s second 777-300ER full-flight simulator – the other is located in Berlin – and will be primarily used to train pilots of the airline’s cargo division. ■

ORDER DAVID KAMINSKI-MORROW LONDON

China Eastern to purchase 15 A330s

China Eastern Airlines is to acquire 15 Airbus A330s to be delivered by 2018, the airline has disclosed in a statement to the Shanghai stock exchange.

China Eastern has not indicated an engine selection for the air-

craft, although its current A330-200s and -300s are fitted with Rolls-Royce Trent 700s.

The carrier values the agreement at \$3.6 billion at catalogue prices, but says that Airbus has granted concessions that

make the actual price “significantly lower”.

Seven aircraft will be handed over in 2017 and the remaining eight in 2018.

China’s state aviation supply company recently opted to take up to 75 A330s, but it is unclear whether the agreement is linked to the China Eastern deal.

Airbus is keen to expand in the Chinese market. As part of its pact covering the 75 aircraft it has signed a framework agreement to establish a completion and delivery centre for A330s in Tianjin.

It is aiming to hand over the first finished widebody from the site by the end of 2017. ■



Carrier’s current fleet is powered by Rolls-Royce Trent 700 engines



Triton set for
operational test
DEFENCE P18

SAFETY JON HEMMERDINGER WASHINGTON DC

Freight pilots push for rest time rules

Unions representing cargo carrier crews renew calls for regulations covering flight hours to be harmonised across industry

A union leader representing pilots working for freight airline UPS has continued to call for rules covering duty and rest time to be standardised across the US commercial aviation industry.

Regulations governing duty and rest time were introduced by the Federal Aviation Administration in 2011 in the wake of the Colgan Air crash near Buffalo, New York on 12 February 2009, in which pilot fatigue was cited as a factor. However, the agency exempted cargo carriers from the legislation.

Then, in August 2013, the first

officer of UPS flight 1354 was recorded as saying she was tired during a flight that ended in a fatal early morning crash near Birmingham, Alabama.

The Independent Pilots Association (IPA) trade union says the Birmingham accident serves to underline the need for rule harmonisation. "It's time to close this dangerous loophole that puts our entire aviation system at risk," says IPA president Robert Travis.

"Whether it be through legislation, through the courts or in discussions with UPS, we are deter-



UPS flight 1354
crashed in 2013,
killing the two
crew on board

mined to create a safer working environment for the men and women who fly for UPS."

The IPA expects an appeal

court to rule next year on its legal bid for change, which it started shortly after the 2011 rule was published. The FAA's revised requirements for pilot duty and rest periods have courted controversy for years, ever since the agency backed away from its position that the two pilot groups should be treated equally.

But the final legislation exempted cargo carriers from the new requirements, which set minimum rest periods for passenger airlines at 10h – up from 8h – and limited pilots' flight times to 8h or 9h.

The IPA says pressure from cargo carriers was the cause of the exemption, leading to its court challenge. ■

REPORT

Fatigue of first officer contributing factor in A300-600 crash

The debate on pilot rest rules made it into the cockpit of UPS flight 1354; an early morning service from Louisville, Kentucky, to Birmingham, Alabama on 14 August 2013. The flight was made using an Airbus A300-600 freighter.

"It should be one level of safety for everybody," says captain Cerea Beal Jr, in a transcript of the cockpit voice recorder included in the US National Transportation Safety

Board's final accident report, and released in September 2014. "It makes no sense at all," replies first officer Shanda Fanning. "It should be across the board... whether you are flying passengers or cargo."

"I'm so tired," Fanning later adds.

Sixty-five minutes later the aircraft crashed near Birmingham airport, killing both pilots.

The attributes the crash to pilot error, citing failure by the crew to

monitor altitude and to properly configure the flight computer for the approach, among other errors. It also highlights "the first officer's fatigue due to acute sleep loss" as a contributing factor.

Despite the accident, the FAA defended its rule in a regulatory impact statement published in December 2014, which said bringing cargo airlines into the scope of the regulations would cost \$452 million. ■

INCIDENT DAVID KAMINSKI-MORROW LONDON

Error by Warsaw controller risked ground collision

Polish investigators have determined that a Warsaw tower controller ordered a BAE Systems Avro RJ100 to abort its take-off roll after belatedly realising that another aircraft was crossing the active runway.

The Brussels Airlines RJ100 (OO-DWG), departing runway 29, had reached 80kt (148km/h) and was 250m (820ft) from the intersection of taxiway A when its pilots were instructed to stop.

Polish investigation authority PKBWL says that a European Air Transport Boeing 757-200, which had previously landed on runway 33, had been cleared to trav-

el along taxiway A for the cargo apron – a clearance which authorised it to cross runway 29.

At the same time, the RJ100 was permitted to line up and wait

in preparation for departure, and was then cleared for take-off just as the 757 began crossing.

PKBWL states that taxiway A's stop-bar light for the intersection

was off at the time. The incident took place before sunrise on 17 December, 2014.

Investigators point out that the tower controller ordered the RJ100 to stop its roll after receiving an indication from the ground controller about the 757's presence. It had slowed almost to a complete stop just as the 757 exited the intersection.

PKBWL describes the incident as a "serious threat of collision" and attributes it to simple oversight, with the controller having forgotten the 757's crossing and failed to check that the runway was free of obstruction. ■



The Brussels Airlines RJ100 was at 80kt when it was told to stop



CONTRACT JAMES DREW
WASHINGTON DC

WMD destroyer HAMMER gets \$7.2m boost

The US Air Force could soon have a new air-delivered tool in its arsenal for destroying chemical and biological weapons – the Heated And Mobile Munitions Employing Rockets, or HAMMER.

A \$7.2 million contract recently awarded to General Dynamics Ordnance and Tactical Systems Aerospace furthers the development of a new munitions concept, which involves littering an underground bunker or weapons storage facility with hundreds of 2.4kg (5.5lb) rocket-propelled fireballs designed to incinerate chemical and biological agents at temperatures in excess of 538°C (1,000°F).

The “kinetic fireball incendiaries” would be delivered inside a 907kg BLU-109B bunker-busting bomb, which has enough punching power to penetrate 1.8m (6ft) of reinforced concrete.

A spokeswoman for the air force’s armaments directorate at Eglin AFB, Florida, tells *Flight International* that over the next nine months, General Dynamics will demonstrate three basic subsystem functions – ejection, ignition and dispersal. Additional contract options are available to fund static and sled testing of the complete HAMMER weapon system.

There are currently no flight tests planned, as that depends on the success of the sled tests.

The primary customer for the weapon is the US Defense Threat Reduction Agency, which since its formation in 1998 has been searching for new and creative ways to demolish weapons of mass destruction. ■

DEVELOPMENT BETH STEVENSON LONDON

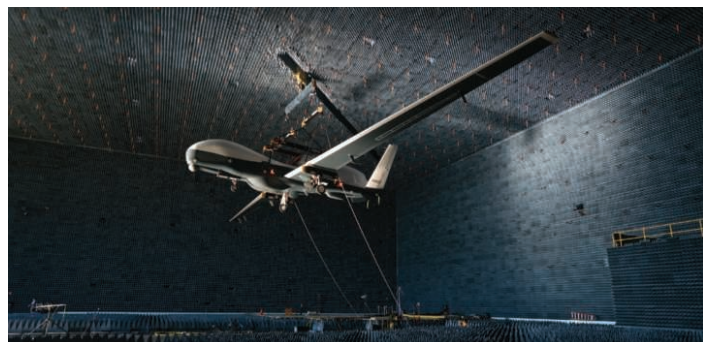
Triton set for operational test

Two-month assessment of unmanned air vehicle will support US Navy production decision

Operational assessment of the US Navy’s Northrop Grumman MQ-4C Triton unmanned air vehicle is set to begin in September, ultimately paving the way for the start of low-rate initial production of the type.

Expected to take two months to complete, the testing will occur at NAS Patuxent River in Maryland. If successful, it will lead to a so-called Milestone C decision, which triggers the award of an initial production contract – anticipated in the second quarter of fiscal year 2016.

Initial operational capability is expected in 2018, in accordance with the programme schedule, says Sean Burke, Triton programme manager at the US Naval Air Systems Command (NAVAIR).



Electromagnetic compatibility testing has begun at Patuxent River

Meanwhile, electromagnetic compatibility testing of the high-altitude, long-endurance UAV has begun. An MQ-4C has been lifted inside Patuxent River’s anechoic chamber for about eight weeks of trials, to ensure its systems do not interfere with each other.

This is the first time a UAV has been controlled from outside the chamber, says NAVAIR.

Besides the USN, the only other customer for the Triton is the Royal Australian Air Force, which plans to acquire up to seven of the type. ■

MILESTONE JAMES DREW WASHINGTON DC

‘Gen 3’ F-35 helmet finally delivered

After more than a decade of development activity, one of the Lockheed Martin F-35’s key technologies; its “Gen 3” helmet-mounted display system, has been delivered and will start being cut into the production line next year.



The technology removes the need for a head-up display

Produced by Rockwell Collins’ and Elbit Systems’ Vision Systems International joint venture, the Gen 3 helmet has at times been almost as controversial as the fifth-generation fighter itself, but will soon be ready for service, with the first unit delivered in August.

Collins announced the delivery plan on 12 August, saying it will be introduced into the fleet as part of F-35 low-rate initial production Lot 7 in 2016.

Gen 3 succeeds the less-capable Gen 2 helmet that the US Marine Corps used to declare initial operational capability in late July, and was delivered following the Pentagon’s cancellation in 2013 of an alternative helmet pro-

gramme with BAE Systems.

The high-technology product allows the F-35 to operate without a traditional head-up display, helmet-mounted display or night vision goggles by combining the three systems into a single unit.

The Gen 3 helmet feeds flight information and sensor data to the pilot throughout the flight, and when combined with Northrop Grumman’s F-35 distributed aperture system and six infrared cameras, the pilot can see through the airframe virtually for 360° situational awareness.

The rollout of Gen 3 was delayed by several years because of technical problems like jittery data displays and poor resolution. ■

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Skunk Works pitches RQ-X as successor to proven U-2
NEWS FOCUS P20

REQUIREMENT BETH STEVENSON LONDON

First T129 ATAK batch for Turkey as TAI eyes exports

With initial nine attack helicopters delivered, manufacturer pushes for international sales

The Turkish army has received its first nine-strong batch of Turkish Aerospace Industries T129 ATAK helicopters, the last of which was delivered on 31 July.

The initial block of the army's AgustaWestland AW129 Mangusta-derived rotorcraft is already operational, says TAI, which touts it as "the most advanced combat helicopter in its class".

TAI started delivering the initial batch of nine "A" model attack helicopters in 2014, and the first examples of the rotorcraft in an advanced "B" configuration with additional weapons are now expected to follow. The A-model types were ordered under an early-entry urgent requirement, and are expected to eventually be converted into B models.

The army has 60 of the 5t rotorcraft on order – with 51 now remaining to be delivered – plus 40



Sixty of the AW129-derived rotorcraft are on order for Ankara

more on option, Flightglobal's Fleets Analyzer database shows.

"[The] T129 ATAK is now ready to meet a range of new export opportunities and requirements in the worldwide market," TAI says. It adds that the endorsement of the Turkish armed forces will mean that "the already strong international interest in the T129

ATAK as a superior alternative is expected to intensify".

The T129 is being promoted to Poland as it seeks to replace its Mil Mi-24s. Other sales targets include the Commonwealth of Independent States, Asia and the Middle East, where the type will participate in the 2016 Bahrain International Air Show. ■

UNMANNED SYSTEMS

JAMES DREW WASHINGTON DC

New retirement timeframe for MQ-1 Predator

The General Atomics Aeronautical Systems MQ-1 unmanned air vehicle will be put out to pasture by 2018, after more than two decades of service, the US Air Force says.

The service has been planning to retire the MQ-1 ever since introducing the larger and more capable General Atomics MQ-9 Reaper in 2007, but the insatiable demand for intelligence, surveillance and reconnaissance and target strikes in conflict zones around the world has kept the original Predator in service.

Now, the air force has set 2018 as the end date for MQ-1 operations and says the aircraft will be moved to the "boneyard", but the ground control stations and other items will be repurposed to support the MQ-9.

"The air force is currently on track to retire all MQ-1 Predators and move to an all-MQ-9 fleet with an estimated completion in 2018," an air force spokeswoman said on 14 August.

Many retirement dates for the MQ-1 have come and gone, but this new timeframe comes after US defense secretary Ashton Carter authorised the air force to reduce its operational tempo from 65 steady-state MQ-1 and MQ-9 combat air patrols, or orbits, to 60 – giving it some breathing room to tweak operations.

According to a Pentagon official, that order was signed in March, amid concern that the long-term health of the remotely piloted aircraft enterprise would be in jeopardy without some relief and more pilots. ■



Reconnaissance type will be flying out of service in 2018

REFURBISHMENT IGOR SALINGER BELGRADE

Croatia shows upgraded MiG-21 fleet

Croatia's air force has received all of its long-delayed refurbished Mikoyan MiG-21bis-D fighters and UMD-model trainers from the Ukrainian Ukrspesexport organisation.

The delivery of seven overhauled aircraft plus five additional single-seat examples under the €13.9 million (\$19.3 million) contract enables the country to field one fully-operational fighter

squadron, and will bridge the gap until a new type is acquired.

Croatian sources blame the delays on issues with integrating the new navigation and communication equipment from Czech supplier CLS, as well as challenges caused by digital-to-analogue signal conversion. Zagreb says it will claim "penalties specified in the contract" for the late delivery.

The last aircraft was received after final flight tests on 16 July, and the squadron was lined up and officially unveiled in full strength in the presence of Croatia's top military officials.

Romania's Aerostar previously conducted an overhaul and limited upgrade to eight MiG-21bis fighters for Croatia, and added four enhanced UMD-model two-seat trainers in 2003.

The Croatian state defence council, chaired by President Kolinda Grabar-Kitarović, announced in April that Zagreb was to maintain a combat fixed-wing fleet, restarting a programme to replace the fighter force.

The defence ministry confirms it has sent requests for information to several companies and embassies as a first step in the acquisition of a new combat type. ■



NATO nation can now field one fully-operational fighter squadron



SURVEILLANCE JAMES DREW PALMDALE

Skunk Works pitches RQ-X as successor to proven U-2

USAF greets optionally piloted concept with muted response, but sticks to retirement plan

Lockheed Martin Skunk Works is looking to write the next chapter in the history of the U-2 “Dragon Lady”, after 60 years of continual global intelligence, surveillance and reconnaissance (ISR) operations.

Today’s U-2 airframes – most of which were manufactured during the 1980s – are only about 20% of the way through their planned 75,000h operating lives, but are to be retired in 2019 at the insistence of the US Air Force, which says it cannot afford to operate the type and its unmanned alternative, the Northrop Grumman RQ-4 Global Hawk.

Originally meant as complementary surveillance assets, the

two aircraft have for years threatened each other’s existence, and the air force has tried many times to put one or other out to pasture.

The U-2 is famous for its spying flights over Russia and China during the Cold War, but the high-flying aircraft designed by Kelly Johnson in the 1950s is busier now than at any point in its history.

Headquartered at Beale AFB in northern California, the specialised surveillance fleet has stepped up its operations from forward bases around the globe in support of everything from traditional treaty verification and mapping missions to snooping on terrorist groups in the Middle

East and Africa, and on more sophisticated rivals like China, Iran, North Korea and Russia.

But with the U-2 now facing retirement, Skunk Works is proposing a next-generation reconnaissance aircraft, optimised for 70,000ft flights but more stealthy than its predecessor.

Skunk Works engineers in Palmdale, California, are considering an evolutionary design, which company officials say could outmatch the best proposals from industry heavyweights Boeing, General Atomics Aeronautical Systems and Northrop.

LOBBYING

Lockheed is also still lobbying hard to keep the U-2 in service, contending that relatively recent upgrades and the low stress of high-altitude flight (on the airframe at least) makes it a viable platform out to 2045. However, it says that if the programme must end, then the USAF should hold a competition for a replacement, since the mission requirement remains.

Officials disclosed details of Lockheed’s optionally manned RQ-X or UQ-2 concept during an 18 August media tour of its U-2 maintenance facility in Palmdale.

“We’re looking at a Global Hawk and U-2, taking the best of breed from both worlds, mixing them together onto one platform,” says Scott Winstead, the company’s strategic development manager for the U-2. “Think of a low-observable [LO] U-2. You’re not going to make it invisible, but LO characteristics would make it more difficult for them to shoot you down. The materials, shape, design and other stuff.”

The current U-2S fleet – consisting of 27 mission aircraft and five twin-seat trainers – received new General Electric F118 engines in the 1990s, and Winstead thinks the powerplant, which is also used on the USAF’s North-



rop B-2 bombers, is the prime candidate for the successor. Lockheed’s suggested new aircraft would also carry many of the same sensors as today, since they are already calibrated to 70,000ft.

U-2 programme director Melani Austin says that with solid requirements, Skunk Works could get to work designing and building the next iteration of the U-2 relatively quickly, and at a reasonable cost. She points to the

“The current fiscal environment does not allow the air force to maintain both platforms”

US AIR FORCE

development of the original U-2A for the US Central Intelligence Agency, which was produced in less than a year and under budget, with 15% of the expected development cost returned to the government.

“If we replicate that environment today and have a really clear set of requirements that don’t change, it would really help any company get to the end of the development phase quickly and cost-effectively,” says Austin.



Sixty years since type’s first flight, the U-2 has never been busier

US Air Force



Despite having much airframe life remaining, the Dragon Lady fleet is facing early retirement in 2019

Lockheed Martin

“Clear requirements make a very straightforward design.”

Winstead says Lockheed is pursuing RQ-X in the traditional Skunk Works way. “If we see anything the air force is interested in anywhere, we start working on it,” he says.

LESSONS

Talk of a next-generation U-2 design comes 60 years after the first flight of the A-model aircraft in August 1955.

Lockheed is likely to take some notes from those six decades as it designs the RQ-X, and this is not the first time it has attempted to design a stealthy U-2.

The U-2 was spotted by Soviet radar on its first overflight, leading to Project Rainbow – an attempt by the CIA to reduce the aircraft’s radar cross-section by using a specialised radar-absorbent coating and “trapeze” wires on the leading and trailing edges of the airframe to deflect electromagnetic energy. The performance trade-off was reduced range and altitude, but the radar absorbing material also acted as an insulant, sometimes causing the original Pratt & Whitney J57 engine to stall, contributing to the death of one pilot. Project Rainbow was cancelled in 1958.

Lockheed could also pull les-

sons from its more recent RQ-3 DarkStar programme, which was its attempt in the late 1990s to create a stealthy unmanned air vehicle. The aircraft is now a fine museum piece.

Today, Skunk Works has far more ways of cloaking a high-altitude flyer, including new stealth coatings. Winstead says the physics of flying at 70,000ft drive certain design principles, like a high aspect ratio wing, rather than the stealthy flying wing design epitomised by the low-observable B-2.

The RQ-X will be “survivable, but not unnoticeable”, says Winstead, who notes that the U-2 is often used for political signalling, as “Something you can see when you want to see it.”

Lockheed says it favours an optionally piloted design, as relying solely on unmanned aircraft for intelligence gathering makes the USA vulnerable, since control links can be disrupted. It also believes that it would be easier to match the capability of the U-2 with a pilot in the loop.

“When they come up with an airplane that is better than the U-2, if it doesn’t have a pilot in it, that’s fine with me,” says Lockheed U-2 test pilot Greg Nelson. “If it’s better than the U-2, I’ll support it and I don’t care who makes it. If it’s a more capable

platform, bring it on.”

Nelson says the Global Hawk is not capable enough to carry the mission solely, and an adversary is less likely to shoot down a manned surveillance aircraft than a UAV, because the political consequences would be far greater.

CONSTRAINTS

While it is actively pursuing RQ-X, Lockheed also recognises that the air force has no stated requirement or timeline to develop a next-generation high-altitude, long-endurance surveillance platform.

“There is a roadmap, but no timeframe,” says Winstead. “[But] when you’re looking at big dollars going toward upgrading old platforms, at what point do you go: why don’t we compete this mission and let everybody compete for it? You end up with something that’s even better.”

But constrained by the US government’s sequestration spending cap, the USAF has no current appetite for starting new aircraft programmes, and priority projects like the Lockheed F-35, Boeing KC-46 tanker, T-X trainer and Long-Range Strike Bomber are consuming most of its development and procurement funding.

The service tells *Flight International* that it remains committed to upgrading the Global Hawk and retiring the U-2 in 2019, and is not considering a recapitalisation programme. While it “views the U-2 and RQ-4 as complementary systems and acknowledges the combatant command-demand for more ISR”, it adds: “The current fiscal environment does not allow the air force to maintain both platforms.”

In late July, the air force signed a co-operative research agreement with Northrop to trial the company’s universal payload adaptor, which is intended to allow the Block 30 Global Hawk to carry many of the modular sensors currently flown on the U-2, such as the Raytheon SYERS-2C multispectral imaging sensor and the wet-film Optical Bar Camera.

However, USAF secretary Deborah Lee James has also approved a so-called “prudent actions list” for the U-2 that includes an improved ASARS-2B radar and L-3 Communications “Gen-3” radio, which would keep the aircraft at peak capability through 2019 – if funded by Congress.

“The air force is pleased that many of these industry partners are looking toward the future to find innovative solutions that cross multiple domains,” the service says of the Lockheed proposal. “However, the air force has just completed the modernisation plan for the RQ-4 to ensure a continuing, optimised capability and is not prepared to discuss follow-on airframes or retirements at this time.”

The service points to its “remotely piloted aircraft [RPA] vector” as its roadmap for future persistent surveillance aircraft. This calls for a more capable, penetrating platform than perhaps is being considered by Skunk Works with the RQ-X.

“Next-generation RPA must detect, avoid and/or counter all anticipated threats – operating from contested to denied airspace in all weather, maintaining persistent ISR in the target area,” the USAF says. ■



James Drew/Flightglobal

Lockheed’s Skunk Works unit wants to continue its ISR legacy



NETWORK DAN THISDELL LONDON

Satcom validates Inmarsat's Jet ConneX services

Satcom Direct is claiming a business aviation first, having validated Inmarsat's upcoming Jet ConneX connectivity service, the business aviation version of its Global Xpress Ka-band system.

The Inmarsat reseller provisioned and tested an Inmarsat Global Xpress Cobham land terminal at its Farnborough facility in the UK, using signals from the Inmarsat-5 satellite that is currently in service over Europe, the Middle East, Africa and Asia. The test validated services including the company's GlobalVT technology, which allows aircraft occupants to make and receive calls and text

"The next generation satellite networks are going to advance airborne data speeds"

JIM JENSEN

Chief executive, Satcom Direct

messages using their own number on their smartphone at any altitude, anywhere in the world, and also used its Satcom Direct Router.

A second Inmarsat-5 satellite is also in orbit, while a third is set to complete the initial geostationary constellation, paving the way for global Jet ConneX services by the end of the year.

When fully deployed, Jet ConneX will support high data-rate applications in flight, including streaming YouTube videos and Skype video calls, in real time.

"The next generation satellite networks are going to advance airborne data speeds in a significant way," says Satcom Direct chief executive Jim Jensen. "We're preparing for the future so that when operators transition to these new networks, the value-added services they utilise are in place."

Kurt Weidemeyer, Inmarsat aviation vice-president for business and general aviation, promises that Jet ConneX will give "travellers the same high standard of connectivity on board private jets". ■

PERSONAL JETS MURDO MORRISON LONDON

FAA approval takes SF50 a step nearer certification

Type inspection go-ahead shows there is 'confidence we can cross finish line', says Cirrus

Cirrus's Vision SF50 has passed another key stage on its way to a year-end certification target, with the US Federal Aviation Administration issuing type inspection authorisation, allowing the agency to evaluate the single-engine jet in flight.

The Duluth, Minnesota-based company has spent nine years in an effort to bring the V-tailed aircraft to market alongside the company's flagship piston-powered SR22.

"This milestone highlights the maturity of our SF50 programme and the FAA's confidence in our ability to cross the finish line," says Pat Waddick, president of innovation and operations.

Cirrus has three production-conforming prototypes in flight test. One of the next crucial steps will be the in-flight evaluation of the ballistic-deployed parachute system. As with the SR22, the jet will be fitted with the potentially life-saving feature, although the



Cirrus Aircraft

Cirrus has spent the last nine years developing the Vision SF50

SF50's will be installed in the nose rather than behind the cockpit.

Load-bearing tests have been carried out on the parachute over the desert using weights equivalent to that of the aircraft, but an in-flight deployment, necessary for certification to be awarded, will take place "in the next month or two", says the company.

Also under way are wing and stabiliser cyclic lifespan and

stress testing, and interiors and paint schemes are being finalised. The first production aircraft are entering assembly, Cirrus adds.

The Cirrus SF50 is the sole survivor of a flurry of single-engine personal jets launched in the first decade of the 2000s. Other programmes, such as the Diamond D-Jet, Eclipse 400, Piper Altaire and Stratos 714, have all been cancelled or are dormant. ■

PROMOTION

Aeris pops up to tap wealthy Harrods shoppers with special edition Eclipse

There are many ways to spend \$3.4 million at Harrods. That list now includes an Eclipse 550 very light jet.

UK Eclipse distributor Aeris Aviation is extending to the end of September a promotion with the upscale London department store to offer a Harrods-branded limited edition of the Eclipse 550 aircraft.

Other extras include a customised paint scheme and \$50,000 on a pre-loaded store card for purchasers.

Aeris, in which Iron Maiden frontman, commercial pilot and aviation entrepreneur Bruce Dickinson is a shareholder,

launched the partnership with Harrods in early August and, although Aeris has not taken any orders yet, the distributor says the shop's wealthy clientele are a perfect fit for the jet brand.

The company has set up a so-called pop-up booth to display a model of the jet in Harrods and talk to potential customers.

One Aviation, the new company behind both Eclipse and the in-development Kestrel 350 turboprop, is aiming for EASA certification of the Eclipse 550 by the end of the year. The then-Eclipse Aerospace received US Federal Aviation Administration certification in late 2014. ■



Aeris Aviation

A model of the Eclipse 550 is on display in the London store



SPACEFLIGHT DAN THISELL LONDON

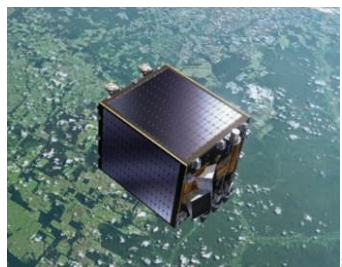
Cubesat trial boost for flight tracking

Tiny Danish satellite's safe arrival at International Space Station is next step to monitoring ADS-B signals from orbit

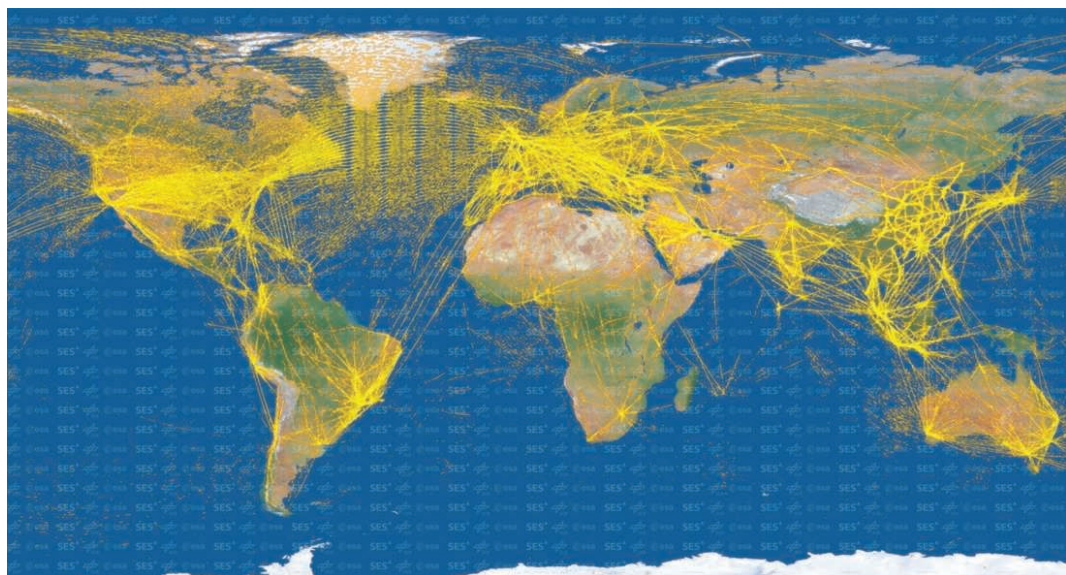
Most of Europe could hear the sound of held breath being released in Denmark on 19 August, as Japan's fifth HTV unmanned resupply vehicle launched successfully from Tanegashima aboard an H-IIB launcher for the International Space Station (ISS). Though three recent resupply missions have ended up in the sea or in smoke, a launch mishap would have left the astronauts on board in no imminent danger of running out of food, air or water – but failure would have been a second disaster for Danish satellite maker GomSpace.

GomSpace's GomX-2 satellite was destroyed along with an Orbital-ATK Cygnus supply capsule when an ISS-bound Antares rocket blew up just above the launch pad at Wallops Island, Virginia on 28 October 2014, but its replacement has reached the ISS and looks set to be deployed into an independent orbit – hopefully by Danish astronaut Andreas Mogensen. Denmark's first astronaut, flying a 10-day mission for the European Space Agency, Mogensen will launch from Kazakhstan on 1 September.

GomX-3 could play a significant role in advancing aviation safety. The tiny three-unit cubesat – measuring just 30 x 10 x 10cm with its antennae packed for launch and deployment, with a mass of just 3kg (6.6lb) – is packing equipment to continue testing the space-based reception of the ADS-B signals emitted by airliners, which tell other aircraft and air traffic controllers their location, course and speed.



Proba-V has proven that aircraft can be tracked from orbit



ESA produced this map with less than two years' data from an experimental ADS-B receiver in orbit

ADS-B (Automatic Dependent Surveillance – Broadcast) signals allow the tracking of individual aircraft, but also give a picture of overall air traffic. And, the signals will be critical to the operation of advanced air traffic control systems, especially the North American NextGen and European SESAR systems, which aim to track all transatlantic aircraft in “4D” – three dimensions of space and one of time – and co-ordinate their flightpaths to save time and fuel, cut delays and effectively increase available air space by directing each aircraft to fly the shortest possible route.

CAPABILITY UPGRADE

ADS-B signalling capability will be mandatory on most aircraft operating in the USA and Europe by the end of the decade, but the signals are designed to be picked up by ground stations to supplement air traffic control radar, particularly where that radar is blind – such as over oceans. For an aircraft to time an arrival at, say, London Heathrow to a few seconds requires mid-Atlantic course adjustment and, clearly, accurate 4D data along its entire route.

Globally, some ocean routes cannot be covered by ground sta-

tions, and stations in remote or politically unstable locations are difficult to install and maintain.

Fortunately, space-based ADS-B detection is promising – even though the signals are broadcast “out” and “down” but not “up”. GomX-1, launched in November 2013 by Dnepr rocket from the Yazny launch base in Russia, was one of the first satellites to detect ADS-B signals in space. GomSpace describes the flight as a “very successful demonstration mission” with “perfect and accurate data reception”, and has given the larger GomX-3 craft an enhanced ADS-B receiver.

GomSpace chief executive Niels Buus tells *Flight International* that he expects GomX-3 to survive six to nine months at its planned 350km orbit. After that, the nanosatellites and radio technology specialist has another ADS-B-focused mission planned for a commercial client, and hopes subsequently to offer “niche solutions”.

Also launched in 2013, ESA's own experimental small satellite (less than 1m³), Proba-V, has separately demonstrated the feasibility of tracking aircraft from orbit. Though its principal mission is to monitor vegetation growth, it produced the map above with

less than two years of data from its experimental ADS-B receiver.

During that time, Proba-V – with a relatively small detection footprint of about 1,500 x 750km (930 x 470 miles) – picked up 25 million position signals from more than 15,000 separate aircraft.

PROGRESS REPORT

In May, Toni Delovski of Germany's DLR aerospace agency, who is overseeing the Proba-V ADS-B experiment, said: “We've shown that detection of aircraft can work from space with no showstoppers, despite the fact that these signals were never designed to be picked up from space.”

There is, he noted, a lot of work that still needs to be done: “We are still working to improve the system. Some makes of aircraft are more easily detected than others, which typically comes down to the age and make of their ADS-B systems.”

GomX-3, meanwhile, is part of an ESA drive to develop downsized – and down-priced – capabilities. Cubesats leader Roger Walker says the craft are an affordable way to try new technology in orbit “and an important driver of miniaturisation”. ■

See Feature P28



Virgin's technology innovation manager says the possibilities are endless for airlines wanting to engage directly with passengers through IoT

AGE OF INTELLIGENCE

The advent of the Internet of Things promises opportunities to improve efficiency and personalisation, but data collection and security issues have to be addressed first

GILLIAN JENNER LONDON

In a world where people casually tout the term disruptive technology, there are few predictions as sure as the coming of the Internet of Things and its potential to change the way we live, travel and operate businesses.

As with all buzzwords, the Internet of Things (IoT) is a concept readily bandied around and just as easily misunderstood. What is IoT? It is things joined up. What things? Any physical object or device; domestic appliances, vehicles, baggage handling equipment, you name it. The limit is our imagination, not the number of devices or objects.

Forecasts about how many things will be connected in the next few years are mind-boggling. They range from calculations by tech researcher Gartner that there will be 25 billion

connected things in use by 2020 to internet networking specialist Cisco IBSG's forecast of 50 billion connected devices. The crucial issue is that these devices will, for the most part, be communicating with each other to negotiate and organise themselves, communicating with people only to take instructions or report back.

Armed as we all are with smart mobile devices, people will also be nodes in this web of internet connections. "Through the devices we carry, we are all effectively IoT endpoints," says SITA technology chief Jim Peters. "Today, our location can be determined, our intent known, our next steps anticipated, our level of stress measured."

The technologies that enable IoT are not in themselves complicated: the latest version of the internet communications protocol, IPv6, which allows for trillions of nodes

(or IP addresses) on the internet and wireless proximity-detecting technologies, such as Bluetooth low energy beacons, radio frequency identification tags and near-field communications.

TALKING DEVICES

As Peters notes, much of the innovation is focused on enabling IoT devices to communicate. Google recently announced Brillo, an underlying operating system for IoT devices, and Weave, a cross-platform common language that will let devices communicate with each other locally and via the cloud.

For the airline sector, IoT offers multiple opportunities to improve operational efficiency and offer increased personalisation to passengers. It may even have the potential to change business models.

Among airlines that have started experi-

menting with IoT, there are projects to improve passenger experience, baggage handling, tracking pets in transit, equipment monitoring and generating fuel efficiencies. Most airline IT bosses are alive to the benefits IoT presents, reveals the 2015 Airline IT Trends Survey produced by SITA in association with *Flight International's* sister publication, *Airline Business*. Two-thirds of them believe IoT offers clear benefits for their airline right now and 86% say IoT will generate benefits over the next three years.

"This mesh of big and fast data and real-time cadence will need to be addressed"

NEETAN CHOPRA

Senior vice-president IT strategic services, Emirates

Today, 37% of airlines have already allocated a budget for IoT implementation, according to the study; however, over the next three years 58% are planning to invest resources into IoT, with the emphasis on pilot projects, although 16% are preparing for major programmes.

So what will this brave new world of connected things look like for aviation? With its Flight Efficiency Services initiative, GE Aviation has already moved beyond the experimental stage. The unit has been working with AirAsia since 2012 to utilise IoT – or the "industrial internet" as GE dubs it – to increase aircraft utilisation and reduce operating costs throughout the low-cost carrier's network, with a target of bottom-line operational savings of \$30-50 million over a five-year term.

Together, GE and AirAsia harnessed the industrial internet to develop a business case that secured approval from Malaysia's Department of Civil Aviation to taxi on one en-

gine on departure. This first for a Malaysian airline translated into saving in excess of 60kg (132lb) of fuel per flight.

SCRATCHING THE SURFACE

Another project, rolled out in 2014, is the collection of data generated by the aircraft and its systems into a fuel management dashboard that also integrates operational, weather, trajectory correction, navigation, and terrain data. This tool has allowed AirAsia to optimise climb profiles, plan taxi and contingency fuel needs, and minimise the use of auxiliary power units.

However, today's use of IoT technologies for greater efficiency is scratching the surface compared with what could be achieved in the future. "IoT applications could improve overall fuel cost (not just the consumption) taking into account energy prices, when/where to refuel, optimal flight and taxi paths as well as when/how much to hedge for the fuel," says GE Aviation's chief technology officer Dave Bartlett. "Beyond that, IoT applications could look at network optimisation, in particular irregular operations recovery options as they continue to try to maximise the utilisation of their fleet while keeping a robust schedule."

It is pretty clear there will be a need to manage vast amounts of data chatter and often to



Not just any other connected thing

provide heavy-lift data processing to devices that do not innately have that capability. Herein lies a key challenge for airline chief information officers.

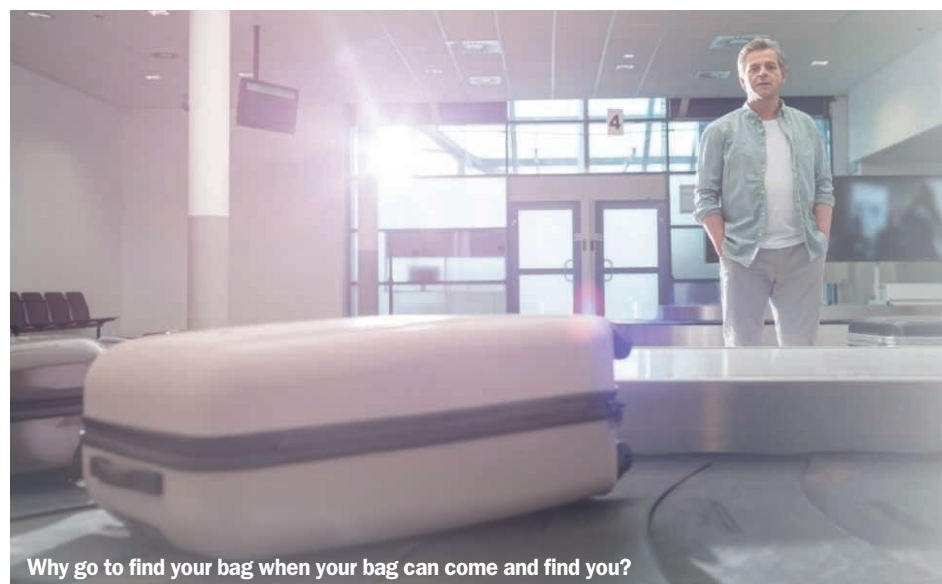
"The volumetric will grow exponentially as sensors, beacons, wearables all start beaming information, connecting to each other as well as enterprise applications. In addition, IoT environments work in real time. This mesh of big and fast data and real-time cadence will need to be addressed in the architectural framework," says Neetan Chopra, senior vice-president of IT strategic services at Emirates.

ENDLESS POSSIBILITIES

But where direct contact with passengers is concerned, the possibilities are wide open. As Tim Graham, technology innovation and development manager at Virgin Atlantic, sees it: "On the ground, it could be mounted displays, mobile or wearable devices combined with sensors... to either help passengers navigate their surroundings, identify themselves at check-in, lounge or boarding areas or track objects such as baggage and cargo."

He adds: "In the air, it could be intelligent aircraft cabins that have sensors built into seats that could monitor passengers' tiredness, temperature or hydration levels to automatically change the cabin environment or alert crew to take a specific action."

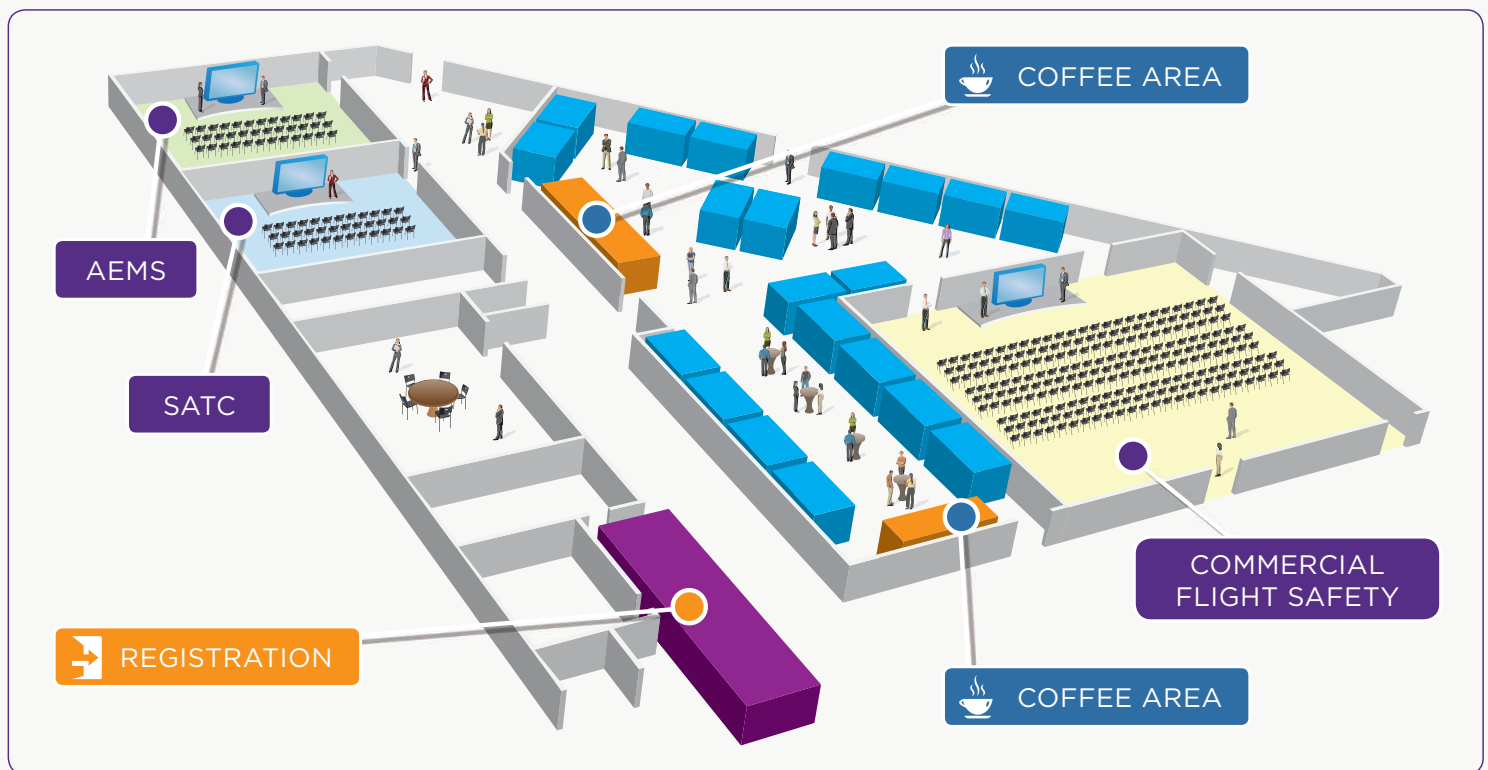
For GE's Bartlett, IoT has the potential to alleviate some of the key pain-points along the passenger's journey for all involved, namely luggage handling and connecting between flights: "For example, being able to track your bags from a smartphone app or maybe even



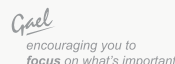
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» have the bags track your location. The bag senses when you enter the luggage area and selects the carousel you are standing closest to and enters that carousel.

“Another challenge is the anxiety felt by passengers over tight connections. Permission-based sensing of the passengers at airports could help airlines to make better informed decisions about when to wait and when to close the door. Imagine the gate texting you saying: ‘I see you have landed. It appears to be about an eight-minute walk to your connecting flight gate. The gate will close in 12 minutes.’”

SENSORY EXPERIENCE

SITA's Peters imagines an on-ground and on-board world that has been heavily “sensorised”, linking staff, passengers and airport equipment such as baggage trolleys and wheelchairs: “Even transfer buses and trains and movements within car parks will be ‘sensorised’. Within the aircraft, sensors will measure cabin temperature, air quality [and] light levels, and track catering equipment and duty-free trolleys.”

This sort of change looks to be coming quickly. The Airline IT Trends Survey reveals that broadly two-fifths of airlines are planning to use beacons at bag drop, baggage claim and check-in by the end of 2018. Few carriers deploy the beacons today.

One pioneer, says Peters, is EasyJet, which launched its Mobile Host initiative in partnership with London Gatwick airport in April. The project combines live data from the airport's systems with Google indoor maps and passenger booking details, location and flight time to provide personalised check-in reminders, directions to bag drop, departures and gate location, plus real-time gate and baggage-belt notifications, direct to passengers' mobile phones.

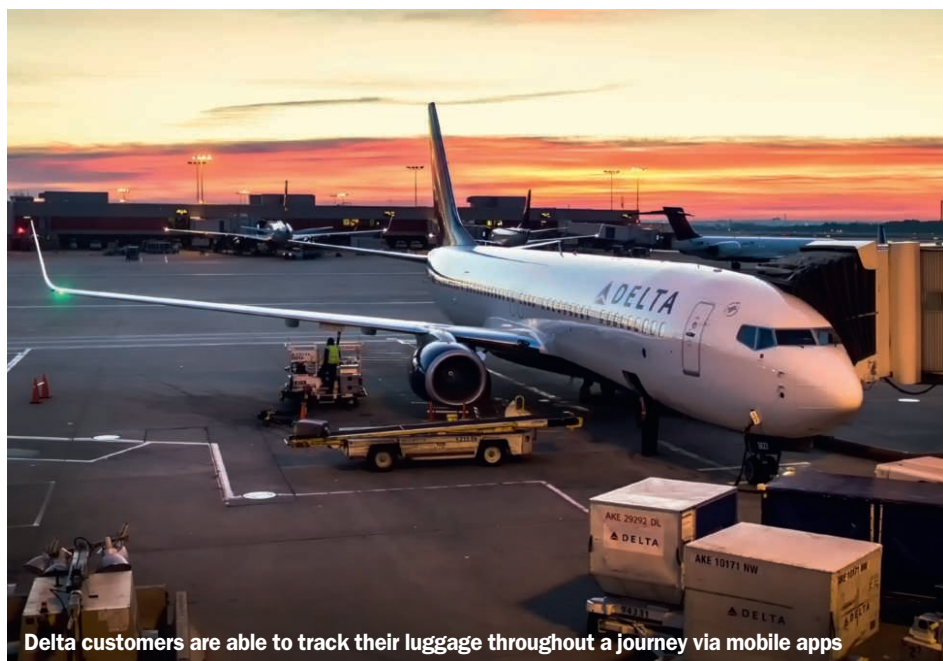
“Thought must be given to the real value and insight provided by the data collected”

TIM GRAHAM

Technology innovation manager, Virgin Atlantic

James Millet, EasyJet's head of digital, adds: “Our Apple Watch app which was available on launch day offers the latest flight information through notifications, currency and weather information as well as boarding passes through Apple Passbook. We've had some great feedback.”

US carrier JetBlue has been experimenting since July 2014 with a fully automated check-in process for customers who have booked its “Even More Space” seats on domestic flights. At 24h before their flight, these passengers re-



Delta customers are able to track their luggage throughout a journey via mobile apps



AirAsia has cut costs as a result of IoT

ceive a ready-to-print boarding pass via email, plus an option to download a pass via the JetBlue iOS or Android mobile apps. Additionally, the airline has a 24h window in which to flag and correct any information inconsistencies or issues with special service requests that would otherwise remain unresolved until the passenger arrives at the airport.

Baggage handling is also high on the IoT list. Tracking bags like you would a parcel via your mobile device is still in its infancy, although Delta Air Lines has enabled its customers to keep a virtual eye on their luggage throughout the journey via its mobile apps since 2011. Earlier this year, Delta Cargo launched a pet-tracking service on domestic flights as part of its GPS tracking services, allowing customers to monitor the humidity, light and temperature that their pet experiences, as well as the animal's location.

Meanwhile, Emirates' IT Innovation Lab has trialled embedding beacon technology into bag tags to improve baggage management at Dubai airport. Chopra adds that Emirates is currently piloting beacons to track engineering assets such as toolboxes and to monitor the condition of equipment such as life jack-

ets without necessarily having to physically inspect them.

Two critical issues, however, potentially stand in the way of connected aviation. One is the airlines' dependence on legacy IT systems. As Virgin's Graham notes: “Right now, there are a lot of competing technologies and frameworks out there when it comes to the IoT. If you combine this with the legacy technology that many airlines face, there's a lot of work to be done on interoperability.”

ROADBLOCKS AHEAD

With the number of connected devices growing exponentially, interoperability issues are clearly a roadblock – and big expense – waiting to happen. Graham's advice is start with limited objectives: “It's important to ensure that thought is given to the real value and insight that the data collected by these devices gives the organisation and, ultimately, the passenger or employee. That's why I think we'll start with tactical deployments.”

Not surprisingly, another challenge will be security. “Securing connected machines has a unique set of complexities that are very different from protecting a data centre,” says Bartlett. “In addition to software platform security, there is a need for protecting critical infrastructure and helping to ensure reliability.”

Finally, as we move into a world that is monitored and orchestrated by sensors, the aviation community as a whole will need to give careful consideration to how it creates and maintains passengers' trust that these processes are genuinely benign. Ultimately what is perceived to be useful and what is perceived to be invasive will define how the IoT evolves. ■

READY FOR AN ICE AGE?

A new European feasibility study is seeking a satellite-based replacement to VHF radio that could revolutionise cockpit communications and air traffic management

DAN THISDELL LONDON

Change is in the air over Europe, in the shape of a concerted attempt by Inmarsat and the European Space Agency to turn satellite communications into a wide-open field for quick and economic development of new applications and services. The result could be to make satellite phones as ubiquitous as ordinary ground-based mobile phones – and one of the first places to feel the impact should be the airliner cockpit.

A nine-month, €4.2 million (\$4.6 million) feasibility study approved in July – with €2 million from ESA, €1.9 million from prime contractor Inmarsat and the other €300,000 coming from sub-contractors Space Engineering Italy, Airbus Defence & Space and RUAG Switzerland – aims to identify technologies, in space and on the ground, that could become standard hardware and software architecture for sat-com equipment and applications. Broadly, this Inmarsat Communications Evolution (ICE) project will attempt to define a smaller, lower-cost satellite-enabled radio terminal, as well as modular components – off-the-shelf chips, essentially – that could cheaply and easily be incorporated into various electronic devices.

Inmarsat's vision is to define a standard sat-

com chip that could, say, easily sit on a GSM phone circuit board to turn what would otherwise be an ordinary phone into a satellite-capable device. The company is focusing this ICE effort on architecture, without attempting to envision the service environment that may follow. It is also hoping that partner and user feedback will inform the design of its next generation of satellites, Inmarsat-6, which are being planned for launch from 2020 and will have to have the technological flexibility to cope with evolving demands over 15 or more years in service.

GIANT LEAP

It may not be overstating the case to imagine that this and other initiatives under way could set off an explosion of satellite-enabled communication and broadband services akin to the leap beyond voice and text that came on the ground when iPhones and other smartphones started to supplement or replace ordinary “dumb” mobiles.

According to Inmarsat's chief technology officer Michele Franci, however, ICE is mainly about safety services, rather than in-flight connectivity for passengers. As such, the drive is to “remodel” the ground-based elements of the L-band network, the 1-2GHz range of the radio spectrum that supports ser-

SESAR would allow for timing London Heathrow arrivals to within a few seconds



vices ranging from GPS to ADS-B aircraft tracking and GSM mobile phones, as well as Inmarsat, Iridium, Lightsquared and Thuraya satellite terminals. In aviation, most of the impact will be in the cockpit.

L-band is significant, as it is more reliable than the Ku-band services – such as Inmarsat's own Global Xpress – that are starting to provide the in-cabin broadband capable of streaming movies and other high-throughput applications.

Critically, Franci wants to come out of this nine-month study having defined an alternative to Inmarsat's BGAN satellite radio/phone terminals. That means much smaller and lighter – about the size of a credit card and maybe the thickness of “two or three” – and much cheaper than the \$20,000-\$50,000 cost of a current BGAN set. A small, modular software-defined radio unit, he believes, could be cheap enough to be accessible to any aircraft operator, even for general aviation aircraft. And, where he describes BGAN today as a “very closed system”, Franci wants to reach a point where a new generation of terminals could make satellite the primary cockpit communications link, replacing the traditional VHF radio that prevails today.

The programme is related to another Inmar-



Growing air traffic volumes are putting increased pressure on conventional VHF networks



High Level/Rex Shutterstock

sat-ESA project, known as IRIS Precursor. That programme, which passed its final design review in July and is now moving into full development, will eventually provide for satellite transmission of air traffic management communications in Europe's next-generation SESAR ATM system.

SESAR is about making European ATM more efficient, in large part to fit a growing amount of traffic into finite sky space. And, notes Franci, VHF networks are reaching saturation – the only way to go is up, so to speak, and that means satcoms.

DEEP IMPACT

The potential impact is wide-reaching. Mary McMillan, Inmarsat's vice-president of aviation services, points out that before satellites made the now common ADS-B position beacons possible, aircraft had to maintain separation of 100 miles (160km) along their flight track and 4,000ft vertically – a “bubble of separation” 200 miles across and 4,000ft deep. But with even the minimum ADS-B frequency of 14min or 15min, that safety zone has been cut to “30-30”: 30 miles fore/aft and horizontally, and 1,000ft deep – effectively tripling available airspace over the Atlantic.



“4D” tracking is only possible by satellite

Robert Hardy/Rex Shutterstock

But in an ATM world ruled by SESAR and the USA's NextGen systems, operators envision timing an arrival at London Heathrow to within just a few seconds, to fly the shortest, most efficient flightpath. To do that, notes McMillan, it will be necessary to make flightpath and speed adjustments “halfway across the Atlantic”. Such continuous “4D” flight tracking (three dimensions of space and one of time) can only be achieved by satellite.

And such a delicately balanced network of hundreds of aircraft will depend on much more than frequent position updates. Aircraft in flight will have to be in continuous communication with each other and with ATM systems. The current generation of Inmar-

sat-4 satellites, says Franci, are doing some of this “machine-to-machine” communication, but they were not designed for it. The Inmarsat-5 satellites being launched now were designed five years ago, and while Inmarsat-6s may well be designed to manage large streams of data, ICE is at root about more efficient use of satellite resources – which will always be limited.

That efficiency takes two forms. First of all is security: for safety systems, communications must be assured, reliable and always available. Ku- and Ka-band links can play a role, but L-band, which is less susceptible to failures such as rain fade, has to be the backbone of the system.

A new generation of terminals could make satellite the primary cockpit communications link

Second is the time-critical nature of each particular message. For voice transmissions, real-time is necessary. For some other messages, a delay of a few seconds is tolerable. Airlines may also like to receive some messages – affecting their on-ground maintenance planning, say – where a delay of minutes is acceptable.

The system, then, will have to automatically make decisions of time sensitivity based on the nature of the message and the density of message traffic. Over airports, where there are many aircraft operating in safety-critical modes, some messages will have to be prioritised at the expense of others that – over the ocean, say – would be transmitted with little or no delay.

To make the most of a spacecraft's bandwidth resources – and current L-band services are only using about 40MHz, a very narrow frequency range – messages will need to be delivered in a “random” way. There will need to be continuous management of the spectrum available, with messages split up to maintain a constant stream while ensuring high-priority messages travel in real time. Franci talks about reducing spectrum waste in terms of “less overhead” – for example, doing away with the “pings” and “handshakes” that currently are used to identify the parties in machine-to-machine messaging.

Fortunately for airlines that would like to quickly get more of the benefits of space-enabled communications, it should not be necessary to wait either for the long-delayed SESAR or NextGen programmes, or for Inmarsat-6. Franci expects to have a solution and partners identified and ready to begin full-scale development of terminals and software by summer 2016 – which could see cockpit upgrades from some time in 2017. ■

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Soviet shuttle's ghostly relics

A fascinating but heartbreaking glimpse into the USSR's space shuttle programme – frozen in time when the regime collapsed – has been provided by a Russian-based photographer who has gained access to the vast abandoned hanger at Baikonur in Kazakhstan, where two Buran prototypes sit falling apart.

Only one orbital flight had been completed when the programme went bankrupt in 1993, and the craft and the facility have been left more or less as they were, save for the ravages of the years.

Ralph Mirebs gained access to one of the craft, which still has its seating and displays intact. You can see the full set of photographs on his blog ralphmirebs.livejournal.com.

The pictures are a remarkable piece of aerospace history and suggest that a few million dollars and a lot of dedication could possibly turn a rotting crypt in the middle of nowhere into a vibrant visitor attraction.

Quick drinking

For any fearful flyer, a tactical nip of brandy before boarding can calm the nerves. But a Chinese passenger took it to extremes when her \$200 bottle of cognac was threatened with confiscation at airport security – instead of letting it go to waste, she downed it on the spot.

Trouble is, unless you're Hemingway, imbibing 700ml of French firewater in the space of



End of the line: inside the crumbling mausoleum to the Soviet Union's ambitions of competing with the US Space Shuttle

a few minutes, can, er, affect the steering mechanism.

By the time she got to the departure gate for her flight from Beijing to Wenzhou, the liquor had firmly hit home, reports the *South China Morning Post*. The captain refused her permission to board, and she was found by police rolling on the floor, screaming and unable to stand up. Needless to say, neither passenger nor cognac made it to Wenzhou that day.

Photochopped

Has the aircraft pictured in this advertisement, er, ground to a halt, asks one correspondent? The inboard engine does seem rather low and the wheels have disappeared. On reflection, we suspect cloudy judgement.



You may rug-ret it

Floor standards

Airports just love their rules, don't they? This photo has been doing the rounds on Twitter.

More yuckspeak

Peter Martin highlights this Yuckspeak job title from a recent issue. A Stephen Trimble (not ours) holds the position of director of processing, exploitation and dissemination, technology systems for UTAS.

"Is his the first A5 business card?" wonders Peter.

Meanwhile, Air France is these days apparently "a global carrier of French inspiration". "All very well," remarks our Rex Stocks. "But judging by its financials, what it wants to be is a carrier of more passengers."

It's a dog's life

Hucks suggested to the lady passenger that at least she

100 YEARS AGO

should leave her toy dog behind. She scornfully refused. But after

a usual sort of flight we found her crouched in the passenger cockpit in a state of nervous prostration. And the toy dog was in a parlous condition.

It's a man's world

Women are being trained as engineers, while skilled

75 YEARS AGO

men are without work. Feminism has swept the country. I enclose

a pamphlet, "The Feminine Invasion", that I shall be pleased to send a copy to any of your readers on receipt of a stamped addressed envelope.

All on automatic

The Autoland system in the Trident will be fully triplicated

50 YEARS AGO

– all channels operating simultaneously and in parallel will

be constantly compared. In the event of discrepancy a majority vote puts the third channel out of operation; with any subsequent failure while on duplex (one-in-ten-million probability) the automatics hand over to the human pilot.

A bit shortsighted

The misplacement of a single washer in the reflective null

25 YEARS AGO

corrector used to control one of the mirrors of the Hubble Space

Telescope appears to have caused the instrument's spherical aberration, says Lew Allen, of the NASA Jet Propulsion Laboratory.

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"I'm sorry Hoskins, you simply don't have a leg to stand on"

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Windowless plan isn't new vision

David Clemow wonders whether we might see windowless passenger aircraft operating in the future (*Flight International*, 28 July-3 August).

Three organisations are working on the concept now, the idea being that outside views gained by windows would be replaced by smart screen panels relaying real-time images, or computerised information.

ICAO tells us that Ixion, a private jet concept supported by Technicon Design of France is one example, Spike Aerospace of Boston, Massachusetts another and the Centre for Process Innovation in Sedgefield, UK the third, with the objective being weight reduction.

But there's nothing new under the Sun. When supersonic airliners were being designed in the 1950s, manufacturers contemplated omitting windows for the same and other reasons. Wisely, they decided against the idea, but installed the smallest windows they could get away with on Concorde.

Roy Allen

Saham Toney, Norfolk, UK

INVESTIGATION

Finding answers from the past

With interest in debris washed ashore on Réunion Island, it's surprising there hasn't been more discussion about the South African Airways Boeing 747 Combi ZS-SAS, that crashed 243nm (450km) to the northeast in November 1987.

It hit the sea vertically while rolled 90° to the right. Floating debris included secondary wing parts such as access panels, leading edges, flaps, and ailerons. Various items were washed ashore on Mauritius, Madagascar, and even South Africa.

If the crew were attempting to correct the bank angle, the right flaperon would have been deflected downwards, and exposed to impact damage to the trailing edge and detachment from the wing. It's a coincidence that this damage is seen on the recovered flaperon attributed to Malaysia Airlines' 777 9M-MRO.

For someone familiar with Boeing flaperons, it would be a 5min job with a tape measure to make an identification, and a few days to write a report. Unfortunately, this information is yet to be released, and the vacuum feeds the eccentric theories and palpable nonsense that were rightly criticised in your Comment (*Flight International*, 11-17 August). It would cost nothing to give the next of kin and the public the full and accurate information they deserve.

Richard Lloyd

Balsall Common, Coventry, UK



Close inspection is required

Swing and miss

The publicity photo of the lady in the hammock slung between parts of the MVP amphibian (*Flight International*, 4-10 August) poses the question: how on earth did she get in?

Ejection, however, will not be a problem – it will be achieved



Ejection seat not necessary

automatically by the wake of the first passing speedboat.

John Russell

Bracknell, Berkshire, UK

Not snap-happy

If the image of the week showing Bombardier 415 water bombers with their propellers "frozen" is an example of great aviation shots (*Flight International*, 11-17 August), then you need to choose more accomplished photographers – in this instance, ones who are able to take photos of aircraft in flight with their propellers suitably blurred.

David Crawford

Gwynneville, NSW, Australia

Keeping it real about training

The article "Unreal Flying" (*Flight International*, 28 July-3 August) is, in my opinion, somewhat misleading.

While it correctly states that today's simulator customers want fidelity all the way to full stall and other edge-of-envelope scenarios, a tuned or enhanced motion system is not capable of providing this.

The simulator manufacturers (and therefore the operators) are totally dependent on the aircraft original equipment manufacturers providing the necessary approved flight test (or engineering) data to permit these areas to be correctly modelled, and at present, they do not do so.

Additionally, the article implies a correlation with Lockheed Martin Commercial Flight Training and zero flight time training (ZFTT).

Under existing regulations, approved ZFTT programmes enable experienced pilots to convert to an aircraft type similar to the one they already operate, solely by the use of an approved Level D full flight simulator and without the need for any modifications to the existing motion system.

John R Smith

Bangkok, Thailand

What strength in numbers, RAF?

With regard to figures recently published of near future Royal Air Force fast jet numbers (*Flight International*, 28 July-3 August), can they possibly be true?

I was horrified to discover that our air strength could be falling to such levels.

Mr S Page

Via email

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15-18 September DSEI 2015

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dsei.co.uk



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flightglobalevents.com/APS15



29-30 September New Generation of Airline Passenger Systems

London, UK
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1 October

US Corporate Aviation Summit

Fort Lauderdale, Florida
aeropodium.com/uscas

1-2 October

Central Asian Aviation Symposium

Almaty, Kazakhstan
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6-8 October

Helitech International

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helitechevents.com

14-15 October

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Palais des Congrès, Bordeaux, France
www.aerospace-innovation-forum.com

20-21 October

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terrapinn.com/exhibition/the-commercial-uav-show

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San Juan, Puerto Rico
alta.aero/airlineleaders/2015

17-19 November

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Nas Vegas, USA
nbaa.org/events/bace/2015

17-19 November

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Kigali, Rwanda
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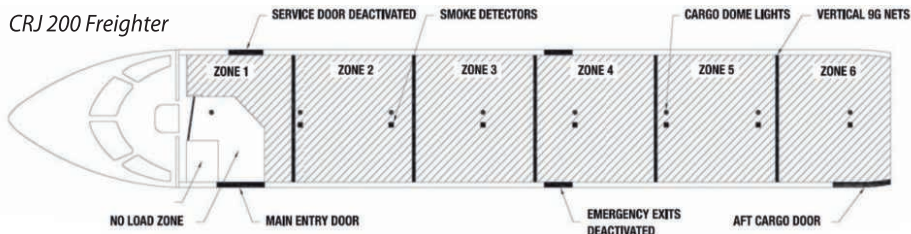


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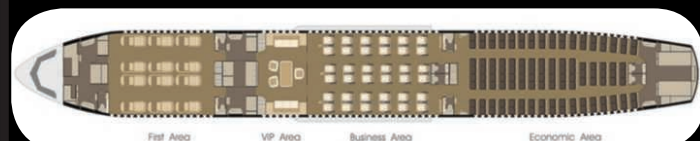
50,173 Hours Total Time, Cycles Since New 9,591

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Type: CFM 56-5C4 Manufacturer: CFMI
Engine #1 741727 Cycles remaining 4,570
Engine #2 741809 Cycles remaining 2,294
Engine #3 741811 Cycles remaining 4,161
Engine #4 741728 Cycles remaining 3,903

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WORK EXPERIENCE MATTHIEU ANGERS

Giving interiors a touch of class

Matthieu Angers is a project manager for MSB Design. He is responsible for overseeing the development of precision-engineered products for the business aviation market at the firm's facility in Boucherville, Quebec

What attracted you to the MSB Design business?

Ten years ago I started at MSB as a mechanical designer and now I'm a project manager, overseeing exciting long-term projects with Fortune 500 companies. When I was hired by MSB, I could see the potential for the company within the aviation sector, which was destined to grow. The company was young and in its development phase, targeting the aeronautics market. I could see that if I worked hard, I could become a project manager on some exciting programmes, while at the same time helping to grow the company. The opportunity was a big part of the attraction, but I couldn't have predicted that MSB would emerge so quickly into the aero market.

What are the biggest challenges when designing for aviation interiors?

We face multiple constraints, such as the space, tight tolerance on interface points in a restricted cabin and, of course, weight. Every kilogram can make a difference to fuel costs, jet category and aircraft performance. Flammability requirements are a factor and environmental issues are becoming increasingly important. Our biggest challenge is to ensure we deliver on time, to the right budget, and to the client's expectations. Invariably schedules are tight, but we pride ourselves on meeting the requirements. It's part of the fun!



Angers constantly reviews project progress to keep schedules on track

What does your average working week consist of?

My working week is about meeting schedules within expected timeframes. I will review project progress internally with my team, and then externally with the clients. These meetings are often away from the office, so I travel quite a bit. I review priorities and schedules to ensure we are operating as efficiently as possible. This involves working with various departments within MSB, such as sales, production, development, and quality control. This liaison between the departments is essential to co-ordinate the many elements of a project, and to make sure it comes to fruition. This variety makes the role very stimulating.

What do you see as the future for interior precision engineering?

From my point of view, the future will revolve around new manufacturing processes and new materials. As these are developed, we expect we'll be able to produce more precise parts, which will certainly change the way we design in the future. This in turn will require improved machining tools to increase the accuracy, and it will also expand our design possibilities. A consequence of this will be the implementation of more automated processes to reduce the human factor. For example, I envision more automated assembly and finishing to eliminate damage in the process.

How do you ensure the company's standards are maintained?

Our reputation is only as good as the standard of the last product we delivered, so maintaining standards is an area we are very focused on. MSB is proud to have received AS9100, the highest certification level for aviation, and ISO 9001 certification in 2008. MSB management and employees are also committed to a continuous improvement process that sees us constantly refining processes and manufacturing methods as well as individual development. I like to think that everyone's goal is to continually improve, and we always encourage the team to share their ideas, both small and large.

What do you enjoy about your work?

Every day with MSB offers new challenges and new opportunities. This motivates me. I'm convinced that if I worked for a big company, I would not have had the same chances in my career. I am passionate about my work and I am proud to be part of the successes of such a fine company. That's really satisfying. ■



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